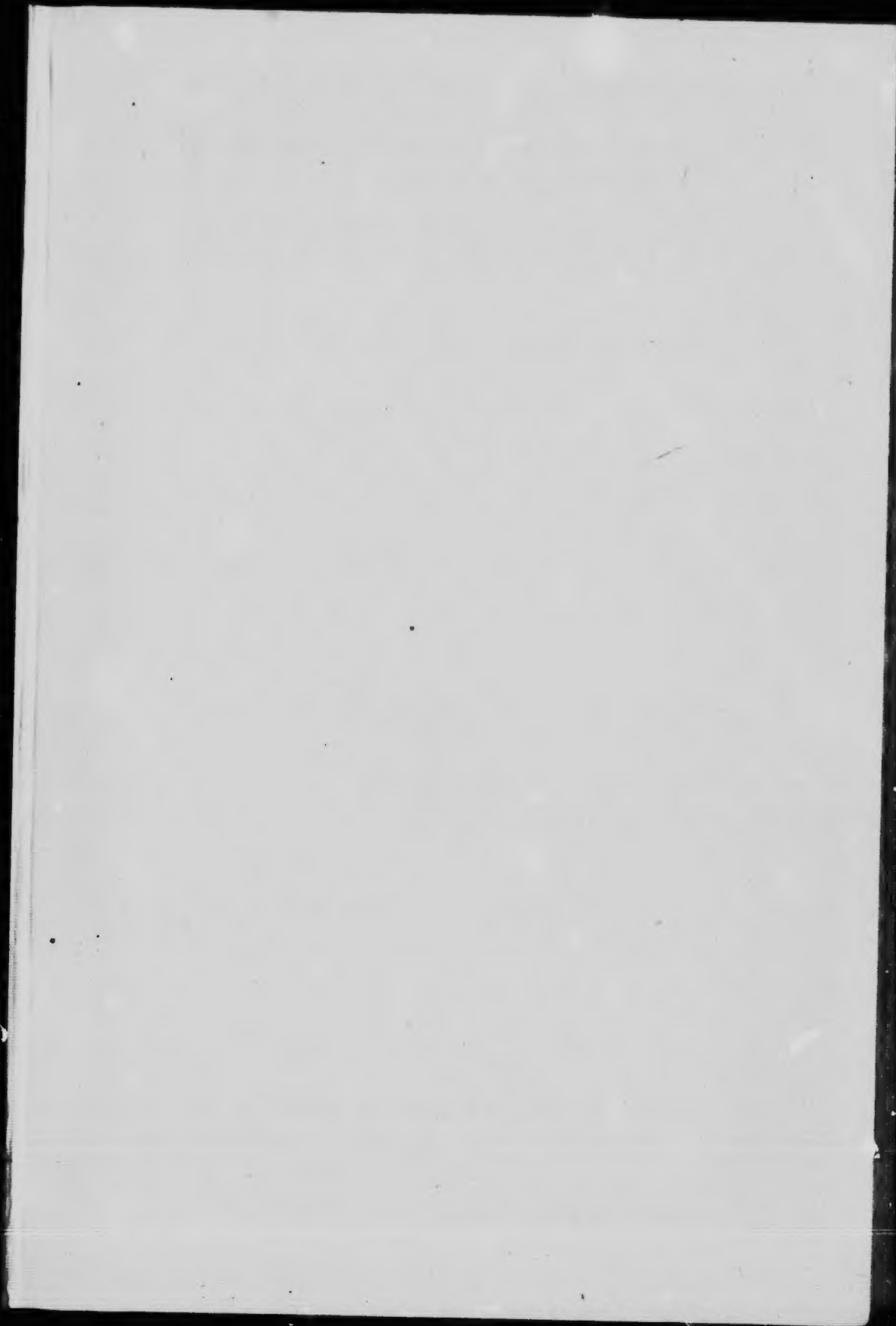


**ELEMENTARY
ARITHMETIC**

**FOR
PUBLIC SCHOOLS**

REVISED EDITION

PART II





ELEMENTARY ARITHMETIC

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PART II



PRICE 25 CENTS

W. J. GAGE & CO. PANY, LIMITED
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1914

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PREFACE

THE authors have had in mind three main purposes in preparing this elementary Arithmetic. These may be briefly stated as follows: (1) To aid pupils in becoming accurate and rapid in calculation; (2) to train them in independent thinking and in applying their knowledge of number to the actual business transactions of life; and (3) to aid the teacher in assigning applications of the various principles which have been explained in the class.

The work consists of two parts. Part I. is designed to carry the pupil through the fifth grade, or to cover the first four or five years at school.

Part I. begins with two chapters on number work covering the ground which should be already familiar to the pupil. These review exercises are intended to accustom pupils to the use of a text-book in a subject which hitherto has been entirely oral to them.

A chapter on easy simple fractions has been introduced at an early stage, as the authors believe that, contrary to the opinion of many teachers, when properly presented, fractions present little difficulty to the young mind. The difficulty lies largely in the use of fractional numbers too large to be comprehended by the average pupil.

As many pupils leave school before the sixth and later grades are reached, easy decimals, percentage, and interest have been introduced, since these are subjects that are constantly met with in the ordinary business transactions of life.

Numerous mechanical and practical exercises on the fundamental rules for seat work form an important feature of the book. It is believed that these exercises form a well-graded and progressive series such as will develop the reasoning powers of the pupil and at the same time familiarize him with the important practical applications of the science of numbers.

Part II. is designed to complete the public school course. In this part there is a careful review of the work of Part I., in which the subjects treated in it are expanded and adapted to the growing mind of the learner. The new material which has been added will, it is believed, supply those applications of the science of numbers which are needed by the average pupil in later years.

The *inductive* method of development has been followed. The child has been led to draw his own conclusions and form his own rules. Definitions have, however, been carefully worded, as experience has shown that, when the child is left entirely to himself to word these, they are usually lacking in that exactness which is one of the essential features of all good teaching.

The review exercises at the end of each chapter and the special reviews introduced to cover all the part previously made familiar to the pupil will, it is thought, secure for the treatment all the advantages of the "Spiral method" without its many obvious disadvantages.

THE AUTHORS.

NOTE.—Answers to the problems in this book, together with hints for the solution of the more difficult problems, will be found in the "Handbook to Elementary Arithmetic, Parts I and II, for Public Schools."

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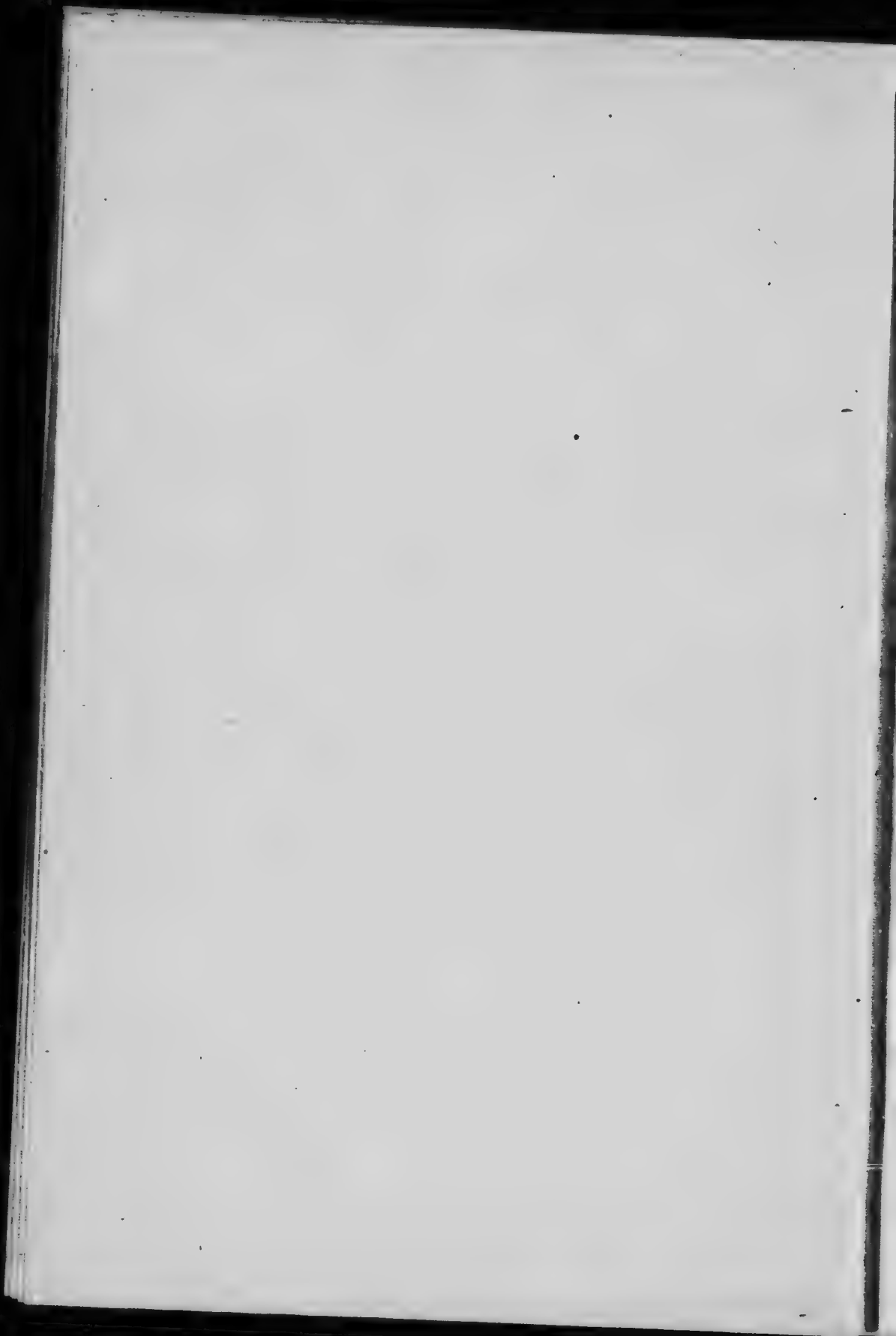
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ELEMENTARY ARITHMETIC

PART II

CHAPTER I

REVIEW EXERCISES

I. NOTATION AND NUMERATION

EXERCISE 1

Point off the following numbers into periods and read each number:

1. 361280202; 275248604; 720006; 201204000; 2002012.

2. 607070; 8100180; 10150105; 1015010; 101501; 7007022.

3. 70070220; 700702202; 770077077; 500050005; 6076076.

Express in words:

4. 707.7, 850.79, 5695.06, 473.628.

5. 564.18, 7840.06, 4005.07, 36000.41.

6. 3000.71, 901,007, 720,009, 1820.106.

7. 31400.06, 50000.604, 36000.107.

8. 404004.001, 440000.04, 40004.004.

9. 500500500.01, 505005050.05, 5005000.505.

10. 77007700.707, 8097088007.06, 904000440.001.

11. 516362076.401, 700000001.002, 9200700700.704.

12. Name the periods in order to the left of the decimal point, as far as trillions.

Write in figures the following:

13. (a) Eight hundred thousand and eight.
 (b) Eight hundred thousand and eighty.
 (c) Eight hundred thousand, eight hundred.
 (d) Eight thousand, eight hundred and eight.
 (e) Eight thousand, eight hundred and eighty.
 (f) Eighty thousand, eight hundred.
14. (a) Onemillion, onethousand, onehundred and one.
 (b) Onemillion, tenthousand, one hundred and ten.
 (c) One million, one hundred and one thousand and one.
 (d) One million, one hundred thousand and one.
 (e) One million and one.
15. One tenth; one hundredth; one thousandth; six tenths; sixty-six hundredths; sixty-six thousandths; seven tenths; seventy hundredths; five thousandths; four hundred and five thousandths; two thousand, and six ten-thousandths.
16. Five, and five tenths; four, and four hundredths; six, and six thousandths; ten, and eleven hundredths; eleven, and seventy-four thousandths; nineteen, and ninety-five ten-thousandths.

EXERCISE 2

Write in Roman numerals:

- | | |
|----------------------|----------------------|
| 1. 444, 999, 949. | 4. 3849, 1844, 1900. |
| 2. 1499, 2409, 1902. | 5. 1794, 1497, 1990. |
| 3. 1875, 1914, 1839. | 6. 2345, 1999, 1444. |

Write in figures:

7. XCIX, MCXXIX, CMXC, CMXCIV, DLIV.
8. MIX, MDIX, MCD, MCCCXXXIX, DXLIV.
9. MDCCCLXXXIX, MDXL, MCDXC, MCMXCV.

- 11

11. Multiply MCMII by MDCCCXIV, and divide the result by CCCXVII.

EXERCISE 3

1.	2.	3.	4.
748569	897368	754596	997857
586977	896584	569784	398579
768497	875734	937565	375578
698954	897598	875543	767457
492327	987796	669988	777888
999777	898978	676767	845854
787878	696969	384567	558899
738437	767678	494949	565656
969696	898989	787856	999999
454545	454545	555777	777888
386386	578578	987987	789789
784784	589768	497584	684634
978996	879845	758759	778899
444555	786387	589964	875578
768479	386487	564936	567849
668492	378489	785939	764879

[illegible]

Subtract and verify the results:

$$\begin{array}{r} 6. \quad 370001884706 \\ \quad 197094793759 \\ \hline \end{array}$$

$$\begin{array}{r} 8. \quad 900700600500 \\ \quad 156987784907 \\ \hline \end{array}$$

$$\begin{array}{r} 7. \quad 550077006301 \\ \quad 184738956975 \\ \hline \end{array}$$

$$\begin{array}{r} 9. \quad 307040502070 \\ \quad 156489765097 \\ \hline \end{array}$$

10. Subtract 78563 ten successive times from 888072, and add the ten successive remainders.

Multiply the following and verify the results:

11. 90007006 by 4060706.

12. 98700987 by 789504.

13. 45678947 by 38090757.

14. 76897957 by 8497652.

EXERCISE 4

Divide the following and prove the results:

1. 768497689 by 5974. 3. 507080903 by 178579.

2. 380078000 by 69368. 4. 910008100 by 3778.

5. What number must be added to 280 so that 133 times the sum will be 95 times 399?

6. Find a number such, that if it is added twenty-nine times to 54678, the sum will be 70541.

7. The product of four numbers is 827658432; the first number is 12, the product of the second and third is 144. Find the fourth.

8. The number 8967 is both divisor and quotient of an example in division, and the remainder is the largest possible. Find the dividend.

9. The quotient is 12434, the remainder 2743, and the dividend eighty-seven million nine hundred and eleven thousand one hundred and twenty-three. Find the divisor.

EXERCISE I

1. A grocer mixed 106 lb. tea costing 38c. per pound, 75 lb. costing 42c. per pound, and 94 lb. costing 45c. per pound, and sold the mixture at 60c. per pound. What was his gain on the whole?

2. If 24 men do a work in 10 days, and 40 boys do it in 8 days, which will be the cheaper—to get boys to do it at 90c. each a day, or men at \$2.50 each a day?

3. How much water must be added to 63 gal. of brandy worth \$4.40 per gallon, in order that the mixture may be worth \$3.60 per gallon?

4. A coal dealer paid \$965 for coal. He sold 160 t. at \$5 a ton, and then the remainder cost him only \$3 a ton. How many tons did he buy?

5. A drover bought 247 sheep at \$4.75 each, and 42 more at \$4.80 each; 8 of them died, and he sold the rest at \$6 each. How much did he gain?

6. Seven hundred and twenty navvies have provisions for 50 days, but after 20 days an additional number arrive, and the provisions are exhausted in 10 days. Find the number of navvies in the additional number.

7. If 26 sheep are worth 5 oxen, 2 oxen are equal in value to 3 horses, and 7 horses can be purchased for \$455, find the value of a sheep.

8. A man hired a laborer on the agreement that for each day he worked he should receive \$1.50 and his board, but for every day he was idle he should pay 50c. At the end of 40 days the laborer received \$40. How many days did he work?

III. COMPOUND NUMBERS

EXERCISE 6

1. Reduce the following to yards:
43 rd.; 101 rd. 2 yd.
2. Reduce the following to rods:
523 yd.; 2507 ft.; 1131 in.
3. Reduce 7 mi. 5 rd. 2 yd. 2 ft. 11 in. to inches, and prove the result by reducing the number of inches to miles, rods, etc.
4. Reduce the following to square yards:
365 sq. rd.; 75 sq. rd. 19 sq. yd.
5. Reduce the following to square rods:
890 sq. yd.; 5000 sq. yd.
6. Reduce 5 a. 39 sq. rd. 3 sq. yd. 7 sq. ft. 100 sq. in. to square inches.
7. From 7 mi. 31 rd. 1 yd. 1 ft. 3 in. take 1 mi. 39 rd. 1 yd. 2 ft. 7 in.
8. A man walked round his farm, which is 3 mi. 25 rd. 3 yd. in perimeter, every day during the month of June. How far did he walk in making the circuits?
9. Divide 313 mi. 208 rd. 4 yd. 1 ft. 11 in. by 19.
10. A person takes 110 steps in a minute, the length of each being 30 in. At what rate per hour does he walk?
11. The fore-wheel of a carriage is 10 ft. in circumference and the hind one is 16 ft. How many more revolutions will one wheel make than the other in going 1 mi.?

EXERCISE 7

1. How many hours are there from noon on June 15 till 9 a.m. on December 31 following?
2. If telegraph posts are placed 80 yd. apart, and a train passes one every 4 sec., how many miles an hour is it running?
3. What will it cost to feed 13 horses for 40 weeks when hay is \$10 per ton and oats 40c. per bushel, if a horse eats 15 lb. of hay and 12 qt. of oats per day?
4. From Belleville to Madoc is 26 mi. 80 rd., and a carriage wheel turns 11088 times in going the distance. Find the circumference of the wheel in feet and inches.
5. A box with a cover is 2 ft. long, 2 ft. wide, and 2 ft. deep on the outside and is made of boards 1 in. thick. How many feet of lumber are required to make it, and how many cubic inches of space are inside it?
6. *A* owns a farm of 25 a. 19 sq. rd. 7 sq. yd.; *B* owns a farm $\frac{1}{4}$ the size of *A*'s; *C*'s is 9 a. 18 sq. yd. 7 sq. ft. less than 9 times as much as *B*'s. Find the amount of land in the three farms.
7. How many miles will a boy walk to plough 3 a., turning a furrow of 9 in.?
8. A man rolling a wheelbarrow takes 85 steps, each 2 ft. 6 in. long, in 1 min. How often will the wheel of the barrow, which is 46 in. in circumference, revolve in 1 hr.?
9. On a field I sow \$17.85 worth of barley, at 84c. per bushel, using 2 bu. and 2 pk. to the acre. Find the size of the field.

EXERCISE 8

1. A cubic foot of wheat weighs 48 lb. How many bushels of wheat will a bin 8 ft. long, 5 ft. wide, and 3 ft. deep hold?
2. Rule in proper form and make out the following bill:
Mr. Thomas Kennedy, bought from Wm. Peterson, Toronto, December 1914: $1\frac{1}{2}$ doz. knives at \$3.50 per dozen; 1 doz. dinner plates at \$3 per dozen. December 6: $1\frac{1}{2}$ doz. cups and saucers at \$1.10 per dozen; $\frac{1}{2}$ doz. forks at \$3 per dozen; 4 pitchers at 50c. Date the bill December 20, and receipt as clerk for Wm. Peterson.
3. What is the total cost of the following: 108 eggs at 24c. per dozen; 128 lb. of pork at \$6.25 per cwt.; 1650 lb. of bran at \$12 per ton; 6060 lb. of wheat at 87c. per bushel; 375 lb. of sugar at 20 lb. for a dollar; 963 lb. of oats at 68c. per bushel?
4. A wagon wheel 11 ft. in circumference, makes 48 revolutions in a minute. How many miles an hour is the wagon travelling?
5. How many bushels of oats are equal in weight to 68 bu. of barley and 51 bu. of wheat?
6. A man bought a rectangular field 40 rd. long by 25 rd. wide, paying therefor at the rate of \$300 per acre, and then had it fenced at the rate of \$1.50 per rod. How much did the field cost him?
7. A farmer sold a load of hay at \$16.25 per ton; the whole weight of the wagon and hay was 2875 lb.; the wagon alone was found to weigh 1083 lb. How much did the farmer receive for his hay?
8. A lot 150 ft. long and 100 ft. wide, is to be surrounded by a close board fence 6 ft. high. What will the boards cost at \$12.50 per thousand feet?

EXERCISE 9

1. If a road is 4 rd. wide, how many miles of it will make 10 a.?

2. If a cow gives 12 qt. 1 pt. of milk every day, and 1 lb. 8 oz. of butter can be made from 25 qt. of milk, how many pounds of butter can be made in one week from the milk of 16 cows?

3. If 1 lb. of thread makes 3 yd. of linen $1\frac{1}{2}$ yd. wide, how many pounds would make 45 yd. of linen 1 yd. wide?

4. If you buy 3 lb. of butter at 28c. per pound, 5 lb. of tea at 56c. per pound, 6 bars of soap at 17c. per bar, 12 gal. of oil at 27c. per gallon, and 3 oranges at 40c. per dozen, and the merchant throws off 10c. for each dollar's worth purchased, how much change would you get out of a \$10 bill?

5. A barn 80 ft. long and 60 ft. wide, is built on a plot of ground 308 ft. long and 204 ft. wide. The rest of the plot is covered with cordwood to a depth of 8 ft. How many cords of wood are there?

6. Some Atlantic liners consume 200 t. of coal per day. They average 8 days out and 8 days back. In case of accidents they carry a supply of 4 days extra. How many cubic yards of the hold of such a steamer will be occupied with coal for her round trip, if each ton is 33 cu. ft.?

7. Find the cost of digging a cellar 48 ft. long, 30 ft. wide, and 6 ft. deep, at 20c. per cubic yard, and flooring it with Portland cement at 35c. per square yard.

8. A load of wood 10 ft. long, 2 ft. 8 in. wide, and 3 ft. high, was sold for \$3.

(a) What was the price per cord?

(b) At \$4 per cord, what would the load be worth?

9. A farmer sold a load of barley weighing 4032 lb., when barley was 40c. per bushel. In weighing the grain the dealer made a mistake and took it as rye and paid for it at 49c. per bushel. How much did the farmer gain or lose by the mistake?

10. A cord of wood and one hundred bushels of grain fill equal spaces. A cubic bin whose edge is 12 ft. contains 45900 lb. of grain. Find the weight of 1 bu. of this grain.

EXERCISE 10

1. What length of road 44 ft. wide will contain 1 a.? What length a chain wide?

2. At \$20 per M, board measure, what will be the cost of 2-inch plank for a 4-foot sidewalk half a mile long?

3. A piece of road 180 ft. long and 66 ft. wide is to be lowered 1 ft. 8 in. How many cubic yards of earth will have to be removed?

4. What length of wall $7\frac{1}{2}$ ft. high and 2 ft. thick can be built with 15 cords of stone?

5. A cubic foot of water weighs $62\frac{1}{2}$ lb., and lead is 11 times as heavy as water. Find the weight of a cubic inch of lead.

6. A farm 90 rd. long and 80 rd. wide is to be divided into 7 fields of equal size. How many acres, rods, yards, feet, and inches will there be in each field?

7. Take a million inches from 100 miles. *Answer must be in miles, rods, yards, feet, and inches.*

EXERCISE 11

1. A man paid for a piece of land 32 rd. wide by giving 240 cords of wood at \$4 per cord. Land being worth \$40 an acre, find the length of the piece of land.

REVIEW EXERCISES

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2. Each side of the roof of a barn is 62 ft. by 25 ft. How many shingles, each covering 16 sq. in. of the roof, will it require?

3. Find the cost, at 24c. per square yard, of plastering the walls and ceiling of a room 35 ft. long, 25 ft. wide, and 10 ft. high, deducting 2 doors 7 ft. by 4 ft., and 4 windows 6 ft. by 4 ft.

4. A field contains 15 a. and is 330 yd. long. What will it cost to build around it a 5-foot close board fence at \$15 per M?

5. How many cubic yards of gravel will be required for 3 mi. of road, the gravel to be laid 9 ft. wide and averaging 8 in. deep?

6. A sulky wheel 14 ft. 8 in. in circumference, made 7200 revolutions in 2 hr. What distance did the sulky go during 1 hr.?

7. Find the cost of wire, at 8c. per 5 yd., for a barbed wire fence 5 wires high, to enclose a field 36 rd. wide and 45 rd. long.

8. In rolling a grass plot 24 yd. long, and containing 400 sq. yd., how many times must a roller 3 ft. 4 in. wide be drawn over it lengthwise so that the whole plot may be rolled?

9. How many cubic feet are there in the schoolroom if it is 30 ft. long, 24 ft. wide, and 12 ft. high? If there are 40 pupils in attendance, how many cubic feet of air does that allow for each pupil?

EXERCISE 12

1. Find the area of a square field if a side is 12 rd.
2. Find the area of a square field if a side is 8 rd. 4 yd.
3. Find the area of a square field if a side is 12 ch.

4. If the middle points of the sides of a section of land are joined by fences, find the area of the square field enclosed within the fences.

5. An oblong field is 100 rd. long and 80 rd. wide. Find how many acres it contains. Find the distance around it. How long will it take a person to plough the field if his horses travel at the rate of 4 mi. an hour, and a furrow is 9 in. wide?

6. Fill in the blanks in the following :

	Area of field.	Length.	Breadth.	Perimeter.
(a)	6 a.	40 rd.	?	?
(b)	?	20 ch.	8 ch.	?
(c)	?	?	20 rd.	100 rd.
(d)	10 a.	?	5 ch.	?

7. Fill in the following blanks:

	Height of box.	Length.	Breadth.	Cubic Content.	Surface.
(a)	6 ft.	4 ft.	3 ft.	?	?
(b)	8 ft.	?	4 ft.	160 cu. ft.	?
(c)	$5\frac{1}{2}$ ft.	4 ft.	?	52 cu. ft.	?

8. Find the cost of excavating the basement of a building 42 ft. long, 28 ft. wide, and 18 ft. deep, at \$2.75 per cubic yard.

9. A cellar 36 ft. long, 24 ft. wide cost \$2240 to excavate at 3.50 per cubic yard. How deep was the cellar?

10. A garden is 99 ft. deep and 44 ft. wide; find:

- (a) Its area in square yards.
- (b) Its area in square rods.

CHAPTER II

FACTORS, CANCELLATION, MEASURES, MULTIPLES

I. FACTORS

EXERCISE 13

1. Give two factors of 10, 35, 14, 77, 33, 55.
2. Resolve into three factors 45, 30, 42, 70, 66.
3. Give the prime factors of 144, 90, 75, 72, 84.
4. Name the prime numbers between 60 and 75.
5. Give all the common factors of each of the following pairs of numbers: 16 and 24; 24 and 30; 36 and 42; 70 and 60; 25 and 35.
6. Give three pairs of numbers that have no common factor.
7. Give the Highest Common Factor of each of the following pairs of numbers: 27 and 36; 72 and 64; 45 and 75; 100 and 75; 125 and 75; 108 and 81.
8. How can you tell without actually dividing whether a number is exactly divisible by 3?
9. Change the digit in the units' place in each of the following numbers to make them exactly divisible by 3: 112, 244, 512, 322.
10. Resolve each of the following numbers into prime factors: 360, 560, 845, 1640.
11. Find the number that has the following factors: 2, 3, 5, 7, and 11.
12. Resolve 249984 into prime factors, and show that it is the continued product of three consecutive numbers. ~~62, 63, 64~~

II. CANCELLATION

EXERCISE 14

1. Simplify each of the following:

$$\frac{9 \times 7}{3 \times 7} =$$

$$\frac{7 \times 5 \times 120}{7 \times 5 \times 30} =$$

$$\frac{15 \times 20 \times 25}{30 \times 50} =$$

2. Simplify $(25 \times 36 \times 11) + (55 \times 4)$.

3. Simplify $(24 \times 27 \times 32) + (36 \times 48)$.

4. Find the value of $\frac{18 \times 22 \times 35 \times 42}{49 \times 33 \times 15}$.

5. Divide the continued product of 20, 35, and 60 by the continued product of 14, 15 and 25.

6. A farmer exchanged 8 bbl. of apples for 240 yd. of cloth at 12c. a yard. Find the selling price of apples.

7. If 256 doz. eggs pay for 56 yd. of cloth at 96c., what is the price of eggs?

8. If 360 sheep are exchanged for 25 horses at \$144, what is each sheep worth?

9. A man worked 8 days for 24 bu. of potatoes worth 40c. a bushel. How much did he earn each day?

10. How many tubs of butter (54 lb.) at 28c. a pound will pay for 378 yd. muslin at 16c. a yard?

11. At what price per doz. must 260 doz. eggs be sold to pay for 78 yd. silk at 95c.?

12. Find the quotient obtained by dividing the continued product of the even numbers between 11 and 21 by the continued product of the numbers 1 to 8 inclusive.

13. A number has the following factors: 8, 15, 24, 42, 65, and 77. Divide this number by the continued product of all the prime numbers less than 15.

III. MEASURES

EXERCISE 15

1. Find the common factors of 248 and 356. Ascertain whether each common factor of 248 and 356 is also a factor of 108, their difference.

2. Write two numbers having a common factor. Find their sum and their difference and discover whether the common factor of the two numbers is a factor of their sum and also of their difference.

3. Write two numbers having a common factor. Take any multiple of one of them and find whether the common factor of the two numbers is a factor of the difference between this multiple and the other number.

1. *It will thus be seen that a common factor of two numbers is also a factor of the difference between the numbers, or of the sum or the difference between a multiple of one of them and the other.*

2. To find the H. C. F. when the numbers are large.

Example 1. Find the H. C. F. or G. C. M. of 52 and 91.

$$\begin{array}{r}
 52 \overline{)91} 1 \\
 \underline{52} \\
 39 \overline{)52} 1 \\
 \underline{39} \\
 13 \overline{)39} 3 \\
 \underline{39} \\
 0
 \end{array}$$

13 is a divisor of 39 and, therefore, of $13+39$ or 52. Since it divides 39 and 52 it also divides $39+52$ or 91; 13 is therefore a divisor or factor of 52 and 91.

It is also the Greatest Common Factor. If not, let a greater number divide 52 and 91, it will then divide 39, their difference and dividing 39 and 52 it will also

divide their difference, or 13. That is, a greater number than 13 will divide 13, which is impossible; 13 is therefore the Greatest Common Divisor, or H. C. F. of 52 and 91.

Hence, to find the H. C. F. of two numbers,

(1) Divide the greater number by the less.

(2) Divide the less by the remainder.

(3) Divide the first remainder by the second, and continue this process, always dividing the last divisor by the last remainder. The last remainder which divides the preceding divisor, is the Greatest Common Divisor, or Highest Common Factor.

EXERCISE 16

Find the H. C. F. of:

1. 115 and 161.

7. 6006 and 3318.

2. 333 and 592.

8. 2871 and 4213.

3. 697 and 820.

9. 43902 and 49593.

4. 392 and 672.

10. 23940 and 28350.

5. 405 and 900.

11. 32480 and 44544.

6. 1220 and 2013.

12. 18577 and 40012.

8. To find the H. C. F. of more than two numbers. First find the H. C. F. of two of them; then find the H. C. F. of the common factor thus found and a third number; and so on through all the numbers. The last common factor found will be the H.C.F. of all the numbers.

EXERCISE 17

Find the H. C. F. of:

1. 1435, 1064, 2135.

3. 4795, 3395, 6048.

2. 14385, 20391, 49287.

4. 5463, 6677, 7891.

EXERCISE 18

1. A rectangular field is 6880 ft. long and 4840 ft. wide. Find the length of the longest string that will exactly measure either a side or an end of the field. 20'
2. A land-owner has three fields containing 24 a., 18 a., and 42 a. He wishes to cut them into smaller fields of an equal number of acres each, but the largest possible. How large will the fields be? 6 a.
3. Three men living on a new street own land fronting as follows: *A*, 600 ft.; *B*, 720 ft.; *C*, 900 ft. They wish to cut their land into lots of an equal width. How wide will the lots be, and how many will each have if they are as wide as possible? 60 ft.
10, 12 & 15 lots
4. *A*, *B*, *C*, and *D* start together and travel the same way round an island which is 600 mi. in circuit. *A* goes 20 mi. per day, *B* 30, *C* 25, and *D* 40. How long must their journeyings continue in order that they may all come together again at the starting point? L.C.M. here
120 d.
5. Three rooms are 120, 132, and 156 inches wide, respectively. What is the width of the widest boards that will exactly floor each room? 12"
6. *A* and *B* purchased horses at the same rate per head. The value of *A*'s horses was \$623 and of *B*'s \$1068. How many horses did each buy? A 7
B 12 at \$1068
7. Find the largest and the smallest numbers that will divide 64610 and 72204, leaving as remainders 27 and 23, respectively. /
3799
8. Find the least number which, taken from 6000, leaves a remainder of which 67 is a divisor. 37
9. What is the greatest equal length into which three trees can be cut, the first being 84 ft. long, the second 105 ft., and the third 119 ft.? 7'

IV. MULTIPLES

EXERCISE 19

1. Name three multiples of each of the following numbers: 5, 7, 8, 9, $2\frac{1}{2}$, $3\frac{1}{2}$.
 2. Name the numbers of which the following numbers are multiples: 21, 35, 55, 63, 77.
 3. Name 4 numbers that contain both 2 and 7 as factors.
 4. Name the least number that is a multiple of 4 and 7; of 6 and 11; of 5 and 8; of 6 and 9; of 8 and 12; of 10 and 15; of 9 and 12.
 5. Make a list of five multiples common to 2, 3, and 4; to 3, 4 and 6; to 4, 5, and 6; to 2, 3, 4, and 5.
- Find the Least Common Multiple of:
- | | |
|------------------------|--------------------------|
| 6. 12, 15, 18, and 20. | 9. 32, 36, 48, and 60. |
| 7. 20, 25, 30, and 32. | 10. 36, 60, 72, and 84. |
| 8. 30, 40, 50, and 60. | 11. 56, 60, 84, and 112. |
12. Find three numbers that on being divided by both 4 and 5 will leave a remainder of 1.
 13. Find the three smallest numbers that on being divided by both 5 and 6 will leave a remainder of 2.

EXERCISE 20

1. Find the L. C. M. of 11, 7, 21, 28, 22, 27, 81, 243, 216, and the G. C. M. of 94605 and 96509.
2. (a) What multiple of 595 divided by 595 gives as quotient 595?
(b) Find the least common multiple of \$2, \$3, \$4, \$5, \$10, \$20, \$50, and \$100.
3. What is the smallest sum of money with which you can buy chickens at 25c., or geese at 50c., or turkeys

FACTORS, CANCELLATION, MEASURES, MULTIPLES 27

at 75c., or lambs at \$3, or sheep at \$5, or pigs at \$7, or cows at \$35, or horses at \$140, and have exactly \$15 left for expenses?

4. A certain hall 60 ft. long is to be carpeted. It is found that by stretching the carpet lengthwise, any one of four pieces, the width, respectively, being $\frac{1}{4}$ yd., 1 yd., $1\frac{1}{4}$ yd., and $1\frac{1}{2}$ yd., will exactly fit the hall without cutting anything from the width of the carpet. If the narrowest piece, worth \$1.10 per yard, be chosen, what will be the least cost of carpeting the hall?

5. Find the smallest number of bushels of wheat which would equal in weight an exact number of bushels of rye or of barley.

6. There are four bells, each of which strikes at intervals of 3, 7, 12, and 14 sec. The four begin to strike at 12 o'clock. When will they next strike together, and how often will they strike in unison in 7 min.?

7. Three men whose steps are 2 ft. 6 in., 2 ft. 9 in., and 3 ft., start to walk together with their left feet forward. How often will they put the left foot down together in walking a mile?

8. Two cog-wheels, containing 48 and 56 cogs, respectively, are working together. After how many revolutions of the larger wheel will two cogs, which once touch, touch again?

9. Two cog-wheels, containing 32 cogs on one and 36 on the other, are working together. The larger wheel makes 64 revolutions per second. How often will the same cogs come in contact during 6 working days of 8 hr. each?

10. The G. C. M. of two numbers is 210; their L. C. M. is 120120; one of the numbers is 2730. Find the other number.

EXERCISE 21

ORAL

1. A drover bought 25 sheep at \$6 a head, and 5 cows at \$42 a head. Find the cost of the whole.
2. Find the least number which, divided by 8, 10, and 12, will leave 3 for remainder in each case.
3. The H. C. F. of two numbers is 3, and their L.C. M. is 36; one of the numbers is 9. Find the other.
4. How many cords of wood are there in a pile 24 ft. long, 4 ft. wide, and 8 ft. high?
5. Multiply 12 by 12, add 6, divide by 10, multiply by 5, divide by 3. What is the result?
6. Find the least number from which 7, 14, and 21 can each be subtracted an exact number of times.
7. If a man take 3 steps in going 10 ft., how many would he take in going a mile?
8. A room is 76 ft. in perimeter and it is 8 ft. longer than wide. Find its dimensions.
9. From $\frac{1}{4}$ of \$125 subtract $\frac{1}{5}$ of \$117.
10. A boy had 7 five-cent pieces, 6 ten-cent pieces, and 3 twenty-five-cent pieces. How much money had he in all?
11. Simplify $12 \times (7 + 8 - 6) \times (112 - 36 \times 3)$.
12. Divide \$22 among A, B, and C, giving A \$2 as often as B gets \$3 and C \$6.
13. 36 is $\frac{1}{4}$ of what number?
14. What is the length of the longest stick that will exactly measure 4 ft., 5 ft. 4 in., and 2 yd. 8 in.?
15. A bought a horse for 20 per cent. less than \$150, and sold him for 10 per cent. more than \$150. How many dollars did he gain?

V. GENERAL REVIEW

EXERCISE 22

1. Divide \$20 between A and B , giving to B half as much again as to A .
2. Find the prime factors of 5005.
3. A room twice as long as it is broad contains 162 sq. ft. of flooring. Find its length and breadth.
4. Find all the common divisors of 560 and 840.
5. Divide 2520 by 280 by resolving each number into its prime factors and cancelling the common factors.
6. The sum of the products of 7 and three other numbers is 231. Find the sum of the three numbers.
7. If the multiplier is 704 and the product is 217536, find the multiplicand.
8. A cistern is 6 ft. long, 4 ft. wide, and 8 ft. deep. How many additional cubic feet of earth must be removed to make it 7 ft. long, 6 ft. wide, and $8\frac{1}{2}$ ft. deep?
9. A house is 44 ft. long and 21 ft. wide, outside measurement. What will it cost to put two floors in it of $1\frac{1}{2}$ in. lumber, the walls being 18 in. thick, and lumber being worth \$60 per M?
10. The divisor and quotient are equal, and the remainder, 907, is the largest possible. Find the dividend.
11. How many rails will enclose a rectangular field 1859 ft. long by 1365 ft. wide, the fence being straight, six rails high, the rails of equal length, and the longest that can be used?
12. A can dig 25 post holes in a day, B can dig 30. What is the least number of post holes which will furnish exact days' labor, either for each working alone or for both working together?

13. Find the prime factors of 8400, 3820, and 1380, and from these write down the G. C. M. and the L.C.M. of these numbers.
14. Find the least amount of tea which can be put up in packets of $\frac{1}{2}$ lb., $\frac{3}{4}$ lb., $1\frac{1}{2}$ lb., or $2\frac{1}{2}$ lb.
15. A rectangular court 42 ft. 6 in. long and 31 ft. 8 in. wide is to be paved with square tiles of equal size and as large as possible. How many tiles will be required?
16. Find all the divisors of 360.
17. Resolve the numbers 3252 and 4248 into prime factors, and from these write down the following:
- (a) All the common divisors.
 - (b) The greatest common divisor.
 - (c) The least common multiple.
18. A wooden pillar is 2 ft. square and 84 ft. high. Find how many cubic feet of wood it contains and its weight if a cubic foot of wood weighs 30 lb.
19. How high is a square pillar—each side 18 in.—if it weighs 360 lb., and the wood weighs 24 lb. to the cubic foot?
20. A boy buys a kodak for \$5. His films cost 45c. for 12 pictures, and it costs 3c. to develop and print each picture. Each picture sells for 10c. Find the profit on 8 doz. pictures, if none are spoiled.
21. The front wheel of a carriage is 9 ft. 4 in. in circumference, and the hind one 11 ft. 8 in. How many miles has the carriage gone when two points on the wheels, which were touching the ground at starting, have touched the ground at the same instant 3168 times?
22. The lumber for a packing case 6 ft. long, 4 ft. 6 in. wide and 3 ft. 4 in. deep cost \$3.10. What did the lumber cost per M?

CHAPTER III

COMMON OR VULGAR FRACTIONS

I. REDUCTION OF FRACTIONS

EXERCISE 23

1. How many halves are there in 2, 3, 4, respectively?
2. How many thirds are there in 2, 4, 5, respectively?
3. How many quarter yards are there in 7 yd.? In $7\frac{1}{2}$ yd.? In $7\frac{1}{4}$ yd.?
4. How many fourths are there in 7? In $7\frac{1}{2}$? In $7\frac{1}{4}$?
5. Reduce 9 to fifths; $9\frac{1}{2}$ to fifths; $5\frac{1}{4}$ to fifths.
6. How is a whole or mixed number reduced to an improper fraction?

Reduce to improper fractions:—

- | | | |
|----------------------|------------------------|------------------------|
| 7. $3\frac{1}{2}$. | 11. $11\frac{1}{17}$. | 15. $51\frac{1}{33}$. |
| 8. $4\frac{1}{2}$. | 12. $12\frac{1}{2}$. | 16. $86\frac{1}{10}$. |
| 9. $9\frac{1}{2}$. | 13. $35\frac{1}{2}$. | 17. $99\frac{1}{11}$. |
| 10. $4\frac{1}{2}$. | 14. $82\frac{1}{2}$. | 18. $78\frac{1}{3}$. |

EXERCISE 24

1. William has 3 oranges. To how many boys can he give one-third of an orange?
2. Express 11 as a fraction with 9 for denominator.
3. A rode a mile each $\frac{1}{10}$ hr. on his bicycle. How far did he ride in $2\frac{3}{10}$ hours?
4. Change 16 to sevenths and 23 to elevenths.

5. Mary has a ribbon $7\frac{3}{4}$ yd. long. If she cuts it into pieces each $\frac{1}{4}$ yd. long, how many pieces will she have?
6. A gave a quarter to each of 18 boys out of a five-dollar bill. How many quarters had he left?
7. What fractions with denominator 32 are equivalent to 4, 8, and 16 respectively?
8. Change $3\frac{1}{2}$ to fourteenths and $9\frac{3}{10}$ to fortieths.
9. How many eighths of a pound are there in $7\frac{1}{2}$ lb.?
10. If $\frac{3}{4}$ yd. of cloth are needed for a vest, how many vests can be made from $11\frac{1}{2}$ yd.?
11. To make badges $\frac{1}{8}$ yd. long for a class, requires $5\frac{3}{8}$ yd. of ribbon. How many pupils are in the class?
12. How many more sixths of a yard are there in $5\frac{1}{2}$ yd. than in $4\frac{1}{2}$ yd.?

EXERCISE 25

1. How many whole yards are there in 6 half-yards?
2. Express 12-quarter hours as whole hours.
3. Express each of the following as whole numbers:
 $\frac{6}{2}$; $\frac{12}{3}$; $\frac{15}{5}$; $\frac{18}{9}$.
4. Express $\frac{15}{4}$; $\frac{17}{8}$; $\frac{21}{8}$; $\frac{25}{8}$ as mixed numbers.
5. Reduce $\frac{9}{2}$; $\frac{12}{3}$; $\frac{24}{8}$; $\frac{35}{5}$ to whole or mixed numbers.
6. How are improper fractions reduced to whole or mixed numbers?

Reduce the following improper fractions to whole or mixed numbers:—

- | | | |
|----------------------|------------------------|--------------------------|
| 7. $\frac{45}{7}$. | 11. $\frac{142}{13}$. | 15. $\frac{324}{25}$. |
| 8. $\frac{78}{8}$. | 12. $\frac{253}{18}$. | 16. $\frac{476}{17}$. |
| 9. $\frac{89}{11}$. | 13. $\frac{982}{15}$. | 17. $\frac{982}{10}$. |
| 10. $\frac{97}{4}$. | 14. $\frac{725}{45}$. | 18. $\frac{4407}{136}$. |

EXERCISE 26

1. From $\$4\frac{2}{3}$ a man paid away \$7. How much money had he left out of this sum?
2. John has $\$2\frac{1}{4}$. He pays away \$5. How much money has he?
3. A number of equal sized pies were cut each into 5 equal parts; there were 45 pieces. How many pies were there?
4. From $2\frac{1}{2}$ yd. of ribbon, $\frac{7}{8}$ yd. were cut. How many eighths of a yard remained?
5. If a bottle holds $\frac{1}{4}$ gal., how many gallons will 7 doz. such bottles hold?
6. How far has A gone, if he rides on his bicycle for $\frac{3}{4}$ hr. at the rate of a mile each $\frac{1}{4}$ hr.?
7. A wishes to measure some oats. He has a bucket which holds one-third of a bushel. The oats fill this bucket 167 times. How many bushels of oats are there?
8. The perimeter of a rectangular room is $2\frac{1}{4}$ ft. It is $5\frac{1}{2}$ ft. longer than wide. Find the dimensions of the room.
9. In walking, A takes 7 steps to a rod. How far has he walked when he has taken 5000 steps?
10. A road 5 mi. long has telegraph poles placed at intervals of $\frac{1}{8}$ mi. How many posts are there?
11. In one scale of a balance there are $1\frac{3}{4}$ lb. How many pound-weights must be placed in the other scale to balance them?
12. If it takes a man the sixth part of an hour to make a cardboard box, how many hours would he be in making 200 boxes, and what is the least number of additional boxes he may make to be employed an exact number of hours?

EXERCISE 27

1. Give three fractions each equal to $\frac{1}{2}$.
2. Give a fraction equivalent to each of the following fractions: $-\frac{2}{3}$; $\frac{1}{4}$; $\frac{3}{8}$; $\frac{7}{9}$.
3. Give other numbers that express the same relation as 2 to 3; as 3 to 4; as 2 to 5; as 3 to 7.
4. Express $\frac{1}{2}$ as fifths and $\frac{2}{3}$ as thirds.
5. Express $\frac{2}{3}$ as sevenths and $\frac{3}{4}$ as eighths.
6. State the condition on which a fraction is equivalent to another.
7. How many twelfths are there in $\frac{1}{3}$? In $\frac{2}{3}$? In $\frac{3}{4}$?
8. Reduce $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{1}{4}$ each to twentieths.
9. " $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{5}{6}$ " " eighteenth.
10. " $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{12}$ " " twenty-fourths.
11. " $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{1}{4}$ each to sixtieths.
12. " $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{5}{12}$ " " thirty-seconds.
13. How many fourths are there in $\frac{1}{2}$? In $\frac{3}{4}$?
14. Reduce $\frac{1}{2}$, $\frac{5}{6}$, and $\frac{2}{3}$ each to fourths.
15. " $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{6}$ " " fifths.
16. " $\frac{2}{3}$, $\frac{1}{2}$, and $\frac{3}{4}$ " " sevenths.
17. " $\frac{1}{3}$, $\frac{2}{3}$, and $\frac{5}{6}$ " " fifteenths.
18. " $\frac{1}{4}$, $\frac{3}{4}$, and $\frac{5}{6}$ " " twentieths.

EXERCISE 28

1. Supply numerators in $\frac{3}{4} = 8$; $\frac{2}{3} = 31$; $\frac{1}{2} = 30$.
2. " " " $\frac{5}{6} = 30$; $\frac{3}{4} = 44$; $\frac{1}{2} = 39$.
3. " " " $\frac{7}{11} = 99$; $\frac{2}{3} = 45$; $\frac{5}{12} = 48$.
4. " " " $\frac{1}{2} = 8$; $\frac{1}{3} = 8$; $\frac{2}{3} = 8$.
5. " " " $\frac{1}{3} = 4$; $\frac{2}{3} = 8$; $\frac{3}{4} = 7$.
6. " " " $\frac{4}{8} = 7$; $\frac{1}{2} = 10$; $\frac{5}{6} = 8$.

7. Supply denominators in $\frac{2}{3} = \frac{10}{?}$; $\frac{3}{4} = \frac{21}{?}$; $\frac{4}{5} = \frac{12}{?}$.
8. " " " $\frac{5}{6} = \frac{25}{?}$; $\frac{7}{8} = \frac{42}{?}$; $\frac{12}{13} = \frac{60}{?}$.
9. " " " $\frac{7}{17} = \frac{56}{?}$; $\frac{9}{13} = \frac{81}{?}$; $\frac{11}{18} = \frac{99}{?}$.
10. " " " $\frac{3}{9} = 1$; $\frac{5}{10} = 1$; $\frac{25}{25} = 1$.
11. " " " $\frac{21}{21} = 1$; $\frac{48}{48} = 1$; $\frac{36}{36} = 1$.
12. " " " $\frac{15}{25} = \frac{3}{5}$; $\frac{28}{28} = 1$; $\frac{84}{84} = 1$.

EXERCISE 29

1. Express $\frac{2}{12}$ as fourths and $\frac{1}{18}$ as thirds.
2. Express the terms of $\frac{3}{4}$ as factors.
3. Express the terms of the following fractions as factors and give an equivalent fraction to each, the terms used being in each case the smallest possible integral number: $\frac{8}{12}$; $\frac{20}{28}$; $\frac{30}{36}$; $\frac{24}{32}$; $\frac{9}{15}$; $\frac{15}{18}$.

4. State how a fraction is reduced to its lowest terms.

Reduce the following fractions to their lowest terms:—

- | | | |
|-------------------------|---------------------------|---------------------------|
| 5. $\frac{15}{20}$. | 1. $\frac{48}{60}$. | 19. $\frac{1200}{1600}$. |
| 6. $\frac{12}{16}$. | 2. $\frac{88}{110}$. | 20. $\frac{1800}{2400}$. |
| 7. $\frac{14}{21}$. | 14. $\frac{700}{900}$. | 21. $\frac{304}{1072}$. |
| 8. $\frac{24}{36}$. | 15. $\frac{840}{1120}$. | 22. $\frac{660}{1155}$. |
| 9. $\frac{75}{100}$. | 16. $\frac{1170}{1560}$. | 23. $\frac{672}{1056}$. |
| 10. $\frac{80}{112}$. | 17. $\frac{910}{1190}$. | 24. $\frac{1584}{2640}$. |
| 11. $\frac{210}{280}$. | 18. $\frac{5400}{7200}$. | |

EXERCISE 30

1. What fraction with the smallest possible denominator has the same value as $\frac{1}{8}$?
2. Draw a line 10 in. long and mark off $\frac{4}{5}$ of it in the easiest way possible.
3. How many quarters are there in $\frac{4}{5}$? In $\frac{1}{5}$?

4. Which is the greater of the two fractions, $\frac{4}{5}$ or $\frac{3}{4}$?
5. Write down five other fractions, each having the same value as $\frac{7}{12}$.
6. Write down five other fractions, each having the same value as $\frac{21}{100}$, and with smaller terms than this fraction.
7. How many sevenths are there in $\frac{4}{7}$? In $\frac{1}{7}$?
8. By how many elevenths is $\frac{1}{11}$ greater than $\frac{1}{18}$?
9. How much is $\frac{1}{11}$ less than $\frac{1}{17}$?
10. If I had \$ $\frac{25}{100}$, to how many people could I give \$ $\frac{2}{100}$?
11. $\frac{3}{10}$ is equal to how many tenths? Fifteenths? Twentieths? Fifths?

EXERCISE 31

1. By what number must the terms be multiplied to reduce $\frac{2}{3}$ to tenths? $\frac{3}{4}$ to twelfths? $\frac{5}{7}$ to twenty-firsts?
 2. Write for $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{5}{6}$, three other equivalent fractions having 12 for denominator.
 3. Express each of the following fractions as twenty-fourths:— $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{12}$.
 4. Name the least number that will contain both 3 and 4.
 5. Name the least number that will contain both 5 and 6; both 4 and 6; both 6 and 8.
- What is the least common denominator to which the following can be reduced:—

- | | | |
|--------------------------------------|--|---|
| 6. $\frac{1}{2}$ and $\frac{1}{3}$? | 9. $\frac{1}{4}$ and $\frac{5}{8}$? | 12. $\frac{1}{4}$ and $\frac{1}{6}$? |
| 7. $\frac{2}{3}$ and $\frac{1}{4}$? | 10. $\frac{5}{7}$ and $\frac{7}{12}$? | 13. $\frac{7}{8}$ and $\frac{5}{12}$? |
| 8. $\frac{2}{3}$ and $\frac{3}{4}$? | 11. $\frac{2}{7}$ and $\frac{3}{14}$? | 14. $\frac{5}{12}$ and $\frac{7}{18}$? |

EXERCISE 32

Reduce to equivalent fractions having the least common denominator:

- | | | |
|---------------------------------------|---------------------------------------|--|
| 1. $\frac{3}{4}$ and $\frac{7}{8}$. | 5. $\frac{2}{3}$ and $\frac{5}{6}$. | 9. $\frac{3}{8}$ and $\frac{7}{9}$. |
| 2. $\frac{1}{2}$ and $\frac{5}{12}$. | 6. $\frac{3}{4}$ and $\frac{5}{6}$. | 10. $\frac{2}{3}$ and $\frac{5}{9}$. |
| 3. $\frac{2}{3}$ and $\frac{3}{11}$. | 7. $\frac{2}{3}$ and $\frac{5}{12}$. | 11. $\frac{2}{3}$ and $\frac{7}{11}$. |
| 4. $\frac{5}{6}$ and $\frac{1}{12}$. | 8. $\frac{1}{2}$ and $\frac{2}{3}$. | 12. $\frac{2}{3}$ and $\frac{7}{9}$. |

EXERCISE 33

Reduce the following to equivalent fractions with the least common denominator:—

- | | | |
|--|--|--|
| 1. $\frac{2}{3}, \frac{5}{6}, \frac{3}{8}$. | 7. $\frac{1}{4}, \frac{7}{12}, \frac{1}{10}$. | 13. 2, $\frac{3}{10}, \frac{1}{5}$. |
| 2. $\frac{1}{2}, \frac{3}{4}, \frac{7}{8}$. | 8. $\frac{5}{6}, \frac{1}{3}, \frac{2}{3}$. | 14. $2\frac{1}{2}, 3\frac{1}{3}, \frac{5}{6}$. |
| 3. $\frac{7}{8}, \frac{1}{10}, \frac{7}{20}$. | 9. $\frac{7}{8}, \frac{2}{4}, \frac{1}{6}$. | 15. $\frac{7}{9}, 4\frac{1}{2}, 5$. |
| 4. $\frac{5}{6}, \frac{7}{12}, \frac{1}{18}$. | 10. $\frac{2}{3}, \frac{3}{8}, \frac{5}{6}$. | 16. 3, $4\frac{1}{2}, \frac{1}{18}$. |
| 5. $\frac{5}{6}, \frac{1}{3}, \frac{7}{12}$. | 11. $\frac{5}{6}, \frac{2}{3}, \frac{1}{6}$. | 17. $\frac{7}{8}, \frac{5}{12}, \frac{5}{12}, \frac{1}{2}$. |
| 6. $\frac{3}{4}, \frac{7}{10}, \frac{5}{6}$. | 12. $\frac{2}{3}, \frac{2}{3}, \frac{1}{4}$. | 18. $\frac{1}{4}, \frac{5}{11}, \frac{9}{11}, 6$. |

EXERCISE 34

1. Express each of these as 36ths, and then arrange the fractions in order of magnitude, beginning with the least: $\frac{5}{12}, \frac{5}{6}, \frac{7}{8}$.

2. Arrange the following fractions in order of their value, putting the greatest first:— $\frac{3}{4}, \frac{6}{9}, \frac{5}{8}, \frac{7}{12}$.

3. Which is the greater, $\frac{1}{3}$ of a field or $\frac{2}{4}$ of the same field?

Find which is the greater:—

- | | | |
|--------------------------------------|--------------------------------------|--|
| 4. $\frac{1}{4}$ or $\frac{5}{8}$. | 7. $\frac{7}{8}$ or $\frac{1}{18}$. | 10. $\frac{5}{34}$ or $\frac{7}{51}$. |
| 5. $\frac{6}{8}$ or $\frac{2}{3}$. | 8. $\frac{1}{10}$ or $\frac{2}{3}$. | 11. $\frac{7}{10}$ or $\frac{1}{10}$. |
| 6. $\frac{7}{8}$ or $\frac{1}{11}$. | 9. $\frac{1}{6}$ or $\frac{1}{11}$. | |

Which is the greatest and which is the least of the following:

12. $\frac{7}{18}, \frac{19}{36}, \frac{11}{18}$?

14. $\frac{3}{18}, \frac{2}{9}, \frac{7}{18}$?

16. $\frac{9}{18}, \frac{13}{18}, \frac{11}{18}$?

13. $\frac{5}{11}, \frac{9}{22}, \frac{11}{22}$?

15. $\frac{9}{10}, \frac{17}{20}, \frac{21}{20}$?

17. $\frac{5}{8}, \frac{7}{8}, \frac{9}{8}$?

Arrange in ascending order of magnitude:—

18. $\frac{11}{18}, \frac{3}{18}, \frac{5}{18}, \frac{4}{18}, \frac{2}{9}$.

19. $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \frac{1}{10}$.

20. Find a fraction, with 60 for denominator, intermediate in value between $\frac{1}{3}$ and $\frac{5}{6}$.

21. Find a fraction, with 112 for denominator, greater than $\frac{1}{4}$ and less than $\frac{1}{3}$.

EXERCISE 35

INTRODUCTORY

- Find $\frac{2}{3}$ of a line a foot long.
- Find $\frac{2}{3}$ of a line $\frac{3}{4}$ of a foot long.
- Draw a rectangle 5 in. by 2 in., and find the area of $\frac{1}{3}$ of it.
- Draw a rectangle 12 in. by 1 in., and mark off $\frac{2}{3}$ of it; then find the area of $\frac{1}{3}$ of the part marked off.
- How do you find $\frac{2}{3}$ of a foot? $\frac{1}{3}$ of a rectangle?
- How do you find $\frac{2}{3}$ of $\frac{2}{3}$ of a foot? $\frac{1}{3}$ of $\frac{2}{3}$ of a rectangle?
- Find $\frac{1}{3}$ of $\frac{1}{3}$ of 120.
- Illustrate by folding paper that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$; $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{8}$; $\frac{1}{3}$ of $\frac{1}{4} = \frac{1}{12}$.
- In the following fractions state whether the primary unit is a whole number or a fraction: $\frac{1}{2}$, $\frac{7}{8}$ in., $\frac{2}{3}$ of a foot; $\frac{2}{3}$ of $\frac{2}{3}$, $\frac{1}{2}$ dozen; $\frac{2}{3}$ of $\frac{2}{3}$ dozen, $\frac{5}{6}$ of $\frac{2}{3}$.
- Fractions like $\frac{1}{2}$, $\frac{7}{8}$ in., $\frac{2}{3}$ of a foot, $\frac{1}{2}$ dozen, $\frac{5}{6}$, which express a number of the equal parts of a unit, are *Simple Fractions*.

5. Fractions like $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{2}{3}$ of $\frac{3}{4}$ dozen, $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{2}{3}$ of $2\frac{1}{2}$ apples, $\frac{2}{3}$ of $\frac{3}{4}$, which express a number of the equal parts of a fraction, are *Compound Fractions*.

10. Classify the following fractions as Simple or Compound:— $\frac{2}{3}$, $\frac{2}{3}$ ft., $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{2}{3}$ of $\frac{3}{4}$ ft., $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{2}{3}$, $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{2}{3}$, $\frac{2}{3}$.

11. What is $\frac{1}{2}$ of 6 ninths? of 10 elevenths? Of 16 twentieths?

12. Find $\frac{1}{2}$ of the following:— $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$.

13. Find $\frac{2}{3}$ of the following:—20, $\frac{2}{3}$, $\frac{2}{3}$.

14. Find $\frac{1}{2}$ of $\frac{1}{2}$.

$$\frac{1}{2} = \frac{1}{1 \times 2}$$

$$\therefore \frac{1}{2} \text{ of } \frac{1}{2} = \frac{1}{2} \text{ of } \frac{1}{1 \times 2} = \frac{1}{1 \times 2}.$$

15. Find the value of the following:—

$$\frac{1}{2} \text{ of } \frac{1}{2}, \frac{1}{2} \text{ of } \frac{1}{2}; \frac{1}{2} \text{ of } \frac{1}{2}; \frac{1}{2} \text{ of } \frac{1}{2}.$$

16. A boy had $\frac{1}{2}$ of a dollar and lost $\frac{1}{2}$ of what he had. What part of a dollar did he lose?

17. A man owned $\frac{1}{2}$ of a farm and sold $\frac{1}{2}$ of his share. Show by means of a diagram that he sold $\frac{1}{4}$ of the farm.

Reduce the following compound fractions to simple ones:—

18. $\frac{1}{2}$ of $\frac{3}{4}$.

20. $\frac{2}{3}$ of $\frac{3}{4}$.

22. $\frac{2}{3}$ of $\frac{3}{4}$.

19. $\frac{1}{2}$ of $\frac{3}{4}$.

21. $\frac{2}{3}$ of $\frac{3}{4}$.

23. $\frac{2}{3}$ of $2\frac{1}{2}$.

24. Compare the numerator of the resulting simple fractions with the product of the numerators of the compound fractions.

25. Compare the denominators of the resulting simple fraction with the product of the denominators of the compound fraction.

26. Give a rule for reducing a compound fraction to a simple one.

EXERCISE 36

Simplify the following fractions:—

1. $\frac{1}{4}$ of $\frac{1}{11}$.
2. $\frac{2}{3}$ of $\frac{3}{8}$.
3. $\frac{3}{4}$ of $4\frac{1}{2}$.
4. $2\frac{1}{2}$ of $\frac{5}{8}$.
5. $\frac{5}{7}$ of $\frac{1}{2}$ of $\frac{2}{3}$.
6. $\frac{1}{5}$ of $\frac{3}{11}$ of $\frac{4}{5}$.
7. $\frac{3}{11}$ of $\frac{7}{8}$ of $2\frac{1}{2}$.
8. $\frac{5}{8}$ of $\frac{7}{8}$ of $\frac{1}{2}$ of $\frac{3}{8}$.
9. $\frac{1}{4}$ of $\frac{3}{4}$ of $\frac{9}{10}$ of $\frac{1}{8}$.
10. $\frac{1}{2}$ of $\frac{1}{4}$ of $\frac{1}{5}$ of $\frac{9}{11}$.
11. $\frac{5}{8}$ of $\frac{2}{3}$ of $\frac{9}{12}$ of $\frac{3}{4}$.
12. $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{1}{8}$ of 7.
13. $\frac{2}{3}$ of $\frac{1}{11}$ of $\frac{1}{12}$ of $5\frac{1}{2}$.
14. $\frac{3}{4}$ of $\frac{1}{11}$ of $\frac{1}{12}$ of $9\frac{1}{2}$.
15. $\frac{7}{8}$ of $8\frac{1}{2}$ of $\frac{1}{2}$ of $2\frac{1}{2}$.
16. $\frac{1}{8}$ of $\frac{3}{8}$ of $\frac{1}{2}$ of $4\frac{1}{2}$.
17. $\frac{3}{8}$ of $\frac{3}{8}$ of $\frac{3}{8}$ of 9.
18. $\frac{1}{5}$ of $\frac{2}{8}$ of $3\frac{1}{2}$ of 6.

EXERCISE 37

1. Some boys owned $\frac{3}{4}$ of a boat; they sold $\frac{1}{4}$ of their share. What part of the boat did they sell?
2. Having $\frac{3}{4}$ of a bushel of potatoes I gave away $\frac{5}{8}$ of what I had. What part of a bushel did I give away?
3. A boy had $\frac{9}{10}$ of a dollar, and spent $\frac{2}{3}$ of it. How much did he spend?
4. A gentleman owning $\frac{3}{8}$ of a factory gave $\frac{2}{3}$ of what he owned to his son. What part of the whole factory was the son's share?
5. A has $\frac{1}{4}$ of a ton of hay, which is $\frac{3}{4}$ as much as B has. How much has B?
 $\frac{3}{4}$ of what B has = $\frac{1}{4}$ of a ton;
 $\therefore \frac{1}{4}$ " " " " = $\frac{1}{3}$ of $\frac{1}{4}$ of a ton = $\frac{1}{12}$ of a ton;
 $\therefore \frac{1}{4}$ " " " " = $4 \times \frac{1}{12}$ of a ton = $\frac{1}{3}$ of a ton;
 \therefore B has $\frac{1}{3}$ of a ton.
6. A owns $\frac{1}{4}$ of a railroad, and $\frac{3}{4}$ of this is $3\frac{1}{2}$ times what B owns. How much does B own?
7. How many acres of land has B, if $\frac{3}{8}$ of 18 is $\frac{9}{28}$ of his number?

8. A 's money equals $\frac{4}{5}$ of \$8750, and A 's is $\frac{3}{8}$ of B 's money. How much money has B ?

9. A rode $2\frac{1}{2}$ hr. at the rate of 12 mi. per hour; B rode $\frac{1}{3}$ of this distance. How far did B ride?

10. A 's money is $\frac{1}{3}$ of B 's; B 's is $2\frac{1}{2}$ times C 's; C has \$3450. How much money has A ?

11. If $\frac{2}{5}$ of the cargo of a ship is worth \$3200, what will be the value of $\frac{3}{5}$ of $\frac{1}{3}$ of the remainder?

12. A farmer sold $\frac{2}{3}$ of $\frac{1}{4}$ of his farm to B and $\frac{1}{4}$ of the remainder to C . C paid \$2345 for his part. At the same rate, what was the value of the farm?

EXERCISE 38

GENERAL REVIEW

1. Write in words 4040+0404.04.
2. Express the following in Roman numerals: 494, 349, 909, 404, 999, 1897, 1909, 1910, 1935.
3. Find the difference between the product and sum of 75 and 705.
4. The divisor and quotient are each 504 and the remainder is the largest possible. Find the dividend.
5. Resolve 2700 into prime factors and from these find 6 divisors of this number greater than 100.
6. Find the number which has all the prime numbers between 16 and 40 for its factors.
7. Resolve 360, 540, and 588 into prime factors and from these determine (1) all the common factors, (2) the greatest common factor.
8. If a man has $\frac{3}{4}$ of a section of land in wheat and a hailstorm destroys $\frac{1}{4}$ of his crop, how many acres of crop are destroyed?
9. Simplify $(16 \times 18 \times 24 \times 32 \times 36) \div (96 \times 144 \times 192)$.

10. Tom's age is $\frac{1}{3}$ of Hal's; Hal's is $\frac{1}{5}$ of his father's age. The father is 57. How old is Tom?
11. A farmer brought $16\frac{1}{2}$ bu. of potatoes to market; to how many persons could he sell $\frac{1}{2}$ of a bushel?
12. A's money is $\frac{1}{4}$ of B's and together they have \$55. How much has each?
13. A huckster sold $\frac{1}{2}$ bu. apples at one house; $\frac{1}{3}$ bu. at another; and $\frac{1}{6}$ bu. at a third. How much did he sell in all?
14. A's money is $\frac{1}{3}$ of \$3560 and A's is $\frac{1}{4}$ of B's money. How much money has B?
15. Make out a bill of the following sales, and show that a payment has been made on account, and that a balance remains due:— $17\frac{1}{2}$ yd. flannel at 40c. per yd., $18\frac{1}{2}$ yd. gingham at 8c. per yard, $20\frac{1}{2}$ yd. tweed at 90c. per yard, 3 felt hats at \$2.70 each, 40 yd. ribbon at 9c. per yard, $90\frac{1}{2}$ yd. cotton at 12c. per yd. Received in payment 50 lb. butter at $22\frac{1}{2}$ c. per pound, and 17 doz. eggs at 18c. per dozen.
16. A boy rubbed a fraction off the blackboard and when asked said that the sum of the numerator and the denominator was 43 and that their difference was 7. What was the fraction?

II. ADDITION OF FRACTIONS

EXERCISE 39

INTRODUCTORY

1. Find the sum of 3c., 4c., and 8c.
2. Add together 3 ten-cent pieces, 4 five-cent pieces and 8 cents.
3. Add 5 yd. and 7 ft.
4. Add 3 lb. and 10 oz. Avoir.
5. Add 2 weeks and 10 days.

6. Find the sum of $\frac{3}{20}$, $\frac{7}{20}$, and $\frac{9}{20}$.
7. Reduce $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ to equivalent fractions with a common denominator, and find their sum.
8. Find the sum of $\frac{1}{2}$ and $\frac{1}{4}$; of $\frac{1}{2}$ and $\frac{1}{3}$; of $\frac{1}{2}$ and $\frac{1}{5}$.
9. Cut squares of paper of equal size and by folding them show that $\frac{3}{4} + \frac{1}{4} = 1$.
10. By using your foot rule show that $\frac{1}{2}$ of 12 in. + $\frac{1}{4}$ of 12 in. = $\frac{7}{8}$ of 12 in.
11. Reduce $\frac{2}{5}$ and $\frac{1}{2}$ each to tenths, and find their sum. Illustrate your work by diagrams.
12. Cut squares of paper of the same size and show that $\frac{3}{4} + \frac{1}{4} = 1$.
13. Reduce $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$ to equivalent fractions with a common denominator, and find their sum.
14. By diagrams show that the sum of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$ is 1.
15. When a number of fractions have a common denominator, how is their sum found?
16. State how you proceed to find the sum of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$.
17. State how fractions are added together.

EXERCISE 40

Add together the following fractions:

- | | | |
|--|--|--|
| 1. $\frac{2}{3}$ and $\frac{3}{4}$. | 5. $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{7}{8}$. | 9. $\frac{3}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{7}{8}$. |
| 2. $\frac{1}{2}$ and $\frac{7}{8}$. | 6. $\frac{4}{8}$, $\frac{9}{10}$ and $\frac{3}{10}$. | 10. $\frac{1}{4}$, $\frac{1}{5}$, $\frac{5}{8}$, and $\frac{3}{4}$. |
| 3. $\frac{5}{12}$ and $\frac{7}{18}$. | 7. $\frac{5}{8}$, $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{12}$. | 11. $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{2}{3}$. |
| 4. $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{3}{4}$. | 8. $\frac{2}{4}$, $\frac{7}{10}$, $\frac{5}{6}$, and $\frac{5}{12}$. | 12. $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{17}$. |

EXERCISE 41

1. A spends $\frac{1}{2}$ of his income on food, $\frac{1}{10}$ on rent, and $\frac{1}{5}$ on clothes. What part of his income does A spend?
2. What fraction of a dollar would $\$ \frac{1}{2}$, $\$ \frac{1}{3}$, and $\$ \frac{1}{4}$ be altogether?

3. In a class, $\frac{1}{3}$ of the pupils have 1 mistake in spelling, $\frac{2}{3}$ have 2 mistakes, and $\frac{1}{3}$ have 3 mistakes. What fraction of the class has mistakes?
4. A man delivered four loads of coal; the first contained $\frac{3}{4}$ of a ton, the second $\frac{1}{2}$ of a ton, the third $\frac{1}{4}$ of a ton, and the fourth $\frac{1}{8}$ of a ton. How much coal did he deliver?
5. A has a journey to make; the first day he goes $\frac{1}{3}$ of it, the second $\frac{1}{3}$ of it, and the third $\frac{1}{3}$ of it. What fraction of the journey did he go in the three days?
6. Add the sum of $\frac{1}{2}$ and $\frac{1}{3}$ to that of $\frac{5}{6}$ and $\frac{1}{3}$.
7. Find the result of adding the sum of $\frac{9}{10}$, $\frac{1}{3}$, and $\frac{1}{4}$ to that of $\frac{1}{10}$, $\frac{1}{3}$, and $\frac{3}{4}$.
8. A grocer sold $\frac{1}{3}$ of a barrel of sugar to one man, $\frac{1}{3}$ of a barrel to a second, and $\frac{1}{3}$ of a barrel to a third. How much did he sell to all?
9. A farmer sold $\frac{1}{2}$ doz. eggs to one woman, $\frac{1}{2}$ doz. to another, $\frac{1}{2}$ doz. to a third, and 2 doz. to a fourth. How many dozen did he sell?
10. To the sum of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$, add the sum of 3, 5, and 4.
11. A saleswoman sold $\frac{1}{2}$ yd. of ribbon to one, $\frac{1}{2}$ yd. to a second, $\frac{1}{2}$ yd. to a third, 3 yd. to a fourth, and 5 yd. to a fifth. How many yards did she sell altogether?
12. A market gardener has $\frac{1}{4}$ a. planted with onions, $\frac{1}{4}$ a. with beets, 1 a. with cabbages, and 2 a. with turnips. How much land has he planted with these four kinds of vegetables?

EXERCISE 42

1. A farmer sold to one man $2\frac{1}{2}$ bu. of potatoes; to another $1\frac{1}{2}$ bu. How many bushels did he sell to these two?

2. Add together $2\frac{1}{2}$, $3\frac{1}{2}$, $7\frac{1}{2}$ and $\frac{1}{10}$.

$$\begin{aligned} & 2\frac{1}{2} + 3\frac{1}{2} + 7\frac{1}{2} + \frac{1}{10} \\ &= 2 + 3 + 7 + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{10} \\ &= 12 + \frac{3}{2} + \frac{1}{10} = 12 + 1\frac{15}{10} = 13\frac{3}{2} = 14\frac{1}{2}. \end{aligned}$$

Find the sum of the following fractions:

- | | |
|---|--|
| 3. $2\frac{1}{2}$, $3\frac{1}{2}$, and $4\frac{1}{2}$. | 9. $2\frac{1}{2}$, $4\frac{1}{2}$, $7\frac{1}{2}$, and $8\frac{1}{2}$. |
| 4. $2\frac{1}{2}$, $\frac{1}{10}$, and $7\frac{1}{2}$. | 10. $7\frac{1}{2}$, $10\frac{1}{2}$, $4\frac{1}{2}$, and $7\frac{1}{2}$. |
| 5. $2\frac{1}{2}$, $3\frac{1}{2}$, and $4\frac{1}{2}$. | 11. $1\frac{1}{2}$, $3\frac{1}{2}$, $2\frac{1}{2}$, and $5\frac{1}{2}$. |
| 6. $3\frac{1}{2}$, $1\frac{1}{2}$, and $\frac{1}{10}$. | 12. $4\frac{1}{2}$, $5\frac{1}{2}$, $3\frac{1}{2}$, and $9\frac{1}{2}$. |
| 7. $1\frac{1}{2}$, $\frac{1}{10}$, and $2\frac{1}{2}$. | 13. $4\frac{1}{2}$, $3\frac{1}{2}$, $4\frac{1}{2}$, and $\frac{1}{10}$. |
| 8. $30\frac{1}{2}$, $4\frac{1}{2}$, and $10\frac{1}{2}$. | 14. $5\frac{1}{2}$, $6\frac{1}{2}$, $3\frac{1}{2}$, and $1\frac{1}{2}$. |

15. At a school picnic $2\frac{1}{2}$ gal. of coffee, $5\frac{1}{2}$ gal. of milk, $4\frac{1}{2}$ gal. of tea, and $1\frac{1}{2}$ gal. of cocoa are drunk. How many gallons are drunk altogether?

16. One box of tea is $2\frac{1}{2}$ lb. heavier than another. The lighter weighs $24\frac{1}{2}$ lb. How much tea is there in the two boxes?

17. One tub of butter has $25\frac{1}{2}$ lb., a second has $24\frac{1}{2}$ lb., a third $27\frac{1}{2}$ lb., and a fourth $30\frac{1}{2}$ lb. How much butter is there in the four tubs?

18. One number is $14\frac{1}{2}$, a second one is $2\frac{1}{2}$ greater than this, and a third one is $4\frac{1}{2}$ greater than the second. Find the sum of the three numbers.

19. One remnant has $2\frac{1}{2}$ yd. in it, a second $1\frac{1}{2}$ yd., a third $\frac{1}{10}$ yd., a fourth $1\frac{1}{2}$ yd., and a fifth $2\frac{1}{2}$ yd. How much cloth is there in the five pieces?

20. A certain town, *A*, is $18\frac{1}{2}$ mi. west of *B*; *C* is $18\frac{1}{2}$ mi. east of *B*; and *D* is $35\frac{1}{2}$ mi. east of *C*. Draw a diagram and compute the distance between *A* and *D*.

21. A farmer sold $145\frac{1}{2}$ bu. of wheat, $248\frac{1}{2}$ bu. of oats, $316\frac{1}{2}$ bu. of peas, and $149\frac{1}{2}$ bu. of barley during the year 1902. How many bushels of grain did he sell that year?

III. SUBTRACTION OF FRACTIONS

EXERCISE 43

INTRODUCTORY

1. What is the difference between 3 fifty-cent pieces and 7 five-cent pieces?
2. Find the difference in length between 2 yd. and 14 ft.
3. Find the difference between 1 day and 32 hours.
4. From $\frac{4}{7}$ take $\frac{1}{7}$, and from $\frac{5}{8}$ take $\frac{1}{8}$.
5. Reduce $\frac{1}{2}$ and $\frac{1}{3}$ to equivalent fractions with a common denominator, and find their difference.
6. Reduce $\frac{2}{3}$ and $\frac{3}{4}$ each to twelfths, and find the difference of the resulting fractions.
7. Reduce $\frac{7}{8}$ and $\frac{3}{4}$ each to eighths, and find their difference.
8. Reduce $\frac{2}{5}$ and $\frac{1}{2}$ each to tenths, and find their difference. Illustrate your work by a diagram.
9. Before subtracting one fraction from another, how must the fractions be expressed?
10. When two fractions have a common denominator, how is their difference found?
11. State how you proceed to find the difference between $\frac{4}{5}$ and $\frac{7}{8}$.
12. By using 120 as a unit, show that $\frac{3}{4} - \frac{2}{3} = \frac{1}{12}$.
13. Using 18 as a unit, show that $\frac{5}{6} - \frac{1}{3} = \frac{1}{6}$.
14. Draw a line 8 in. long and by dividing it, show that $\frac{7}{8} - \frac{3}{4} = \frac{1}{8}$.
15. From $\frac{1}{2}$ take $\frac{1}{3}$; from $\frac{2}{3}$ take $\frac{1}{4}$; from $\frac{5}{6}$ take $\frac{1}{6}$.
16. What is the first step in working each of the examples in Question 15?
17. State how one fraction is subtracted from another.

EXERCISE 44

Find the difference between:

- | | | |
|--|--|---|
| 1. $\frac{5}{7}$ and $\frac{2}{3}$. | 5. $\frac{3\frac{3}{4}}{4}$ and $\frac{1\frac{2}{3}}{3}$. | 9. $\frac{2}{15}$ and $\frac{4}{5}$. |
| 2. $\frac{7}{9}$ and $\frac{2}{3}$. | 6. $\frac{7}{8}$ and $\frac{4}{15}$. | 10. $\frac{9}{14}$ and $\frac{1\frac{1}{2}}{3}$. |
| 3. $\frac{5}{6}$ and $1\frac{1}{2}$. | 7. $\frac{5}{8}$ and $\frac{1\frac{1}{2}}{3}$. | 11. $\frac{1\frac{1}{2}}{3}$ and $\frac{1\frac{1}{2}}{3}$. |
| 4. $1\frac{7}{10}$ and $\frac{1}{5}$. | 8. $\frac{5}{7}$ and $\frac{2\frac{3}{4}}{100}$. | 12. $\frac{9}{35}$ and $\frac{7}{30}$. |

EXERCISE 45

1. A certain fraction is added to $\frac{2}{3}$ and the sum is $1\frac{1}{3}$. What fraction is added to $\frac{2}{3}$?

2. To a certain fraction $\frac{5}{6}$ is added, and when $1\frac{5}{12}$ is taken from the sum the remainder is $\frac{1}{3}$. Find the fraction.

3. Add $\frac{2}{3}$ to the difference between $\frac{4}{5}$ and $1\frac{3}{5}$.

4. Of a pole, $\frac{1}{5}$ is white, $\frac{2}{5}$ red, and the rest blue. What part of it is blue?

5. How much must be added to $1\frac{7}{12}$ to make $3\frac{1}{4}$?

6. Find the sum of the greatest and least of the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{5}$, and find the difference between this sum and that of the other two fractions.

7. The sum of three fractions is $\frac{5}{6}$. Two of them are $\frac{1}{3}$ and $\frac{7}{30}$. Find the third.

8. $\frac{5}{7}$ of an audience are children. If the girls form $\frac{2}{3}$ of the audience, what part of it do the boys form?

9. Out of \$5, a man spent $\$ \frac{1}{5}$. How much had he left?

10. Out of \$10, a woman spent $\$ 2\frac{1}{4}$. How much had she left?

11. From 15 take the sum of 2, 3 and $\frac{1}{2}$.

12. From 20 yd. of ribbon there were sold to one person $1\frac{1}{2}$ yd., to another $2\frac{1}{4}$ yd., and to another $4\frac{1}{2}$ yd. How many yards remain unsold?

EXERCISE 46

1. From 756 take 234. Explain each step.
2. From $8\frac{3}{4}$ take $2\frac{1}{4}$; from $9\frac{5}{8}$ take $6\frac{3}{8}$.
3. From 125 take 89. Explain each step.
4. From 7 take $2\frac{1}{4}$. Explain each step. ($7=6\frac{3}{4}$).
5. From $5\frac{1}{2}$ take $2\frac{3}{4}$. Explain each step.

Find the value of:

- | | | |
|-----------------------------------|------------------------------------|--------------------------------------|
| 6. $3\frac{3}{4}-1\frac{1}{8}$. | 10. $3\frac{5}{12}-1\frac{5}{8}$. | 14. $9-4\frac{3}{4}$. |
| 7. $2\frac{1}{9}-1\frac{1}{10}$. | 11. $2\frac{5}{8}-1\frac{7}{12}$. | 15. $18\frac{2}{3}-3\frac{5}{8}$. |
| 8. $6\frac{1}{2}-2\frac{1}{12}$. | 12. $5\frac{3}{14}-2\frac{2}{7}$. | 16. $28\frac{6}{13}-3\frac{9}{14}$. |
| 9. $8\frac{3}{4}-5\frac{1}{8}$. | 13. $4\frac{7}{8}-1\frac{3}{4}$. | 17. $25\frac{7}{10}-14\frac{1}{2}$. |

EXERCISE 47

Simplify the following:

- | | |
|--|--|
| 1. $\frac{1}{6}-\frac{1}{3}+\frac{1}{6}+2\frac{1}{4}$. | 7. $16-3\frac{1}{2}+4\frac{3}{4}-3\frac{5}{8}$. |
| 2. $1\frac{3}{4}+\frac{5}{8}-1\frac{9}{11}+3\frac{3}{4}$. | 8. $8-4\frac{1}{2}-5\frac{7}{15}+2\frac{5}{12}$. |
| 3. $1\frac{1}{3}+2\frac{5}{6}+\frac{7}{12}-9\frac{1}{4}$. | 9. $7\frac{5}{12}-3\frac{7}{8}+8\frac{1}{4}-10\frac{1}{8}$. |
| 4. $\frac{3}{4}+4\frac{5}{14}-1\frac{1}{21}-2\frac{5}{28}$. | 10. $8\frac{7}{4}-2\frac{3}{16}-4\frac{3}{8}+5\frac{7}{12}$. |
| 5. $1\frac{1}{3}-1\frac{3}{4}-2\frac{1}{4}+5\frac{1}{8}$. | 11. $11\frac{3}{11}-7\frac{5}{22}+4\frac{7}{55}-2\frac{7}{10}$. |
| 6. $50\frac{5}{8}-4\frac{3}{4}-8\frac{1}{8}-5\frac{7}{36}$. | 12. $7\frac{1}{4}+5\frac{3}{8}-8\frac{2}{5}+7\frac{7}{8}$. |

EXERCISE 48

1. The sum of 2 numbers is $26\frac{1}{4}$, and the less is $7\frac{5}{8}$. What is the greater?
2. From a barrel of vinegar containing $31\frac{1}{2}$ gal., $14\frac{1}{2}$ gal. were drawn. How much was there left?
3. To what fraction must the sum of $\frac{1}{3}$ and $\frac{1}{18}$ be added that the sum may be $\frac{1}{4}$?
4. From a piece of silk containing $35\frac{3}{4}$ yd., $14\frac{3}{4}$ yd. were sold. How much remained in the piece?
5. From \$10, $\$2\frac{1}{8}$ were given to James, $\$3\frac{1}{4}$ to Jane, $\$1\frac{1}{2}$ to Emily, and the remainder to Mary. What did she receive?

6. *A* has two farms, one of $70\frac{3}{4}$ a., and the other of $118\frac{1}{2}$ a. If he sells $87\frac{1}{2}$ a., how much land has he left?

7. How much paper has a printer left, if he had on hand $30\frac{7}{8}$ reams, and has used $7\frac{1}{2}$ reams for one job and $8\frac{1}{4}$ reams for another?

8. A grocer, having mixed $15\frac{1}{4}$ lb. of tea with $32\frac{1}{4}$ lb. of a different kind, sold all the mixture but $13\frac{1}{4}$ lb.; how much did he sell?

9. *B* started on a journey of 100 mi.; the first day he travelled $30\frac{5}{8}$ mi., the second day $36\frac{5}{8}$ mi.; how far has he yet to go?

10. Henry had $\$47\frac{1}{2}$, and James as much, lacking $\$9\frac{4}{5}$. How many dollars had James?

11. The selling price of a horse was $\$125\frac{3}{4}$; the gain was $\$26\frac{3}{4}$. What was the cost price?

12. Find the sum of the greatest and least of the fractions $\frac{3}{8}$, $\frac{5}{12}$, $\frac{4}{9}$, $\frac{7}{10}$, the sum of the other two, and the difference of these sums.

EXERCISE 49

1. $\$249\frac{1}{4}$ is $\$134\frac{1}{2}$ less than the value of my horse and carriage. What are they worth?

2. A boy paid $\$1\frac{1}{4}$ for a ball, $\$1\frac{1}{2}$ for a slate, $\$1\frac{1}{4}$ for a knife, and $\$1\frac{1}{2}$ for a book. How much did he spend?

3. What is the entire weight of 4 crocks of butter weighing as follows:—The first $10\frac{1}{4}$ lb., the second $11\frac{1}{2}$ lb., the third $13\frac{5}{8}$ lb., and the fourth $14\frac{1}{2}$ lb.?

4. Three men bought a horse; the first paid $\$41\frac{1}{2}$, the second paid $\$63\frac{1}{2}$, and the third as much as the other two. What was the cost of the horse?

5. A grocer has three barrels of molasses; the first contains $28\frac{3}{4}$ gal., the second $42\frac{7}{8}$, and the third $36\frac{1}{4}$ gal. How many gallons are in the three barrels?

6. What number is that from which, if $5\frac{1}{2}$ is taken, the remainder will be $2\frac{1}{3}$?

7. A merchant sold $34\frac{3}{8}$ yd. of cloth for $\$94\frac{5}{8}$, $39\frac{3}{4}$ yd. for $\$124\frac{3}{4}$, and $70\frac{3}{8}$ yd. for $\$184\frac{3}{4}$. How many yards of cloth did he sell, and how much did he receive for the whole?

8. Four geese weigh, respectively, $9\frac{1}{2}$ lb., $10\frac{3}{4}$ lb., $12\frac{1}{8}$ lb., and $11\frac{5}{8}$ lb. What is their entire weight?

9. A lady hired a gardener at 15c. an hour for 3 days. How much did she pay him if he worked $6\frac{5}{12}$ hr. the first day, $7\frac{1}{2}$ the second, and $5\frac{3}{4}$ the third?

10. If $5\frac{1}{2}$ gal. of brandy are mixed with $1\frac{9}{12}$ gal. of water and $3\frac{5}{12}$ gal. of whiskey, how many gallons are there in the mixture?

11. A paid $\$46\frac{1}{2}$ for an ox, and $\$57\frac{5}{12}$ more than this for a horse. For how much must he sell them to gain $\$26\frac{1}{2}$?

12. A owns $71\frac{5}{8}$ a. of land, B owns $112\frac{5}{8}$ a., C owns $217\frac{1}{4}$ a., and D owns $372\frac{1}{2}$ a. How many acres do they together own?

IV. MULTIPLICATION AND DIVISION OF FRACTIONS

EXERCISE 50

1. Multiply $\$2$ by 6 and 5 lb. by 8.
2. Multiply $\frac{2}{3}$ by 6 and $2\frac{1}{2}$ by 9.
3. How is a fraction multiplied by a whole number?

Multiply:

- | | | |
|-------------------------|--------------------------|---------------------------|
| 4. $\frac{1}{8}$ by 9. | 7. $\frac{1}{4}$ by 10. | 10. $\frac{1}{12}$ by 21. |
| 5. $\frac{1}{3}$ by 8. | 8. $\frac{1}{11}$ by 49. | 11. $\frac{8}{19}$ by 24. |
| 6. $\frac{9}{16}$ by 7. | 9. $\frac{1}{11}$ by 91. | 12. $\frac{1}{11}$ by 36. |

EXERCISE 51

1. Divide \$15 by 3 and 25 mi. by 5.
2. Divide $1\frac{1}{2}$ by 3 and $3\frac{1}{2}$ by 5.
3. Divide $1\frac{1}{4}$ by 3 and $2\frac{1}{4}$ by 3.
4. Simplify $1\frac{1}{2} \div 4$ and $3\frac{1}{2} \div 6$.
5. How is a fraction divided by a whole number?

Divide:

- | | | |
|-------------------------|--------------------------|-----------------------------|
| 6. $1\frac{1}{2}$ by 5. | 9. $1\frac{1}{2}$ by 17. | 12. $4\frac{1}{2}$ by 10. |
| 7. $2\frac{1}{2}$ by 7. | 10. $7\frac{1}{2}$ by 6. | 13. $129\frac{1}{2}$ by 16. |
| 8. $8\frac{1}{2}$ by 9. | 11. $4\frac{1}{2}$ by 7. | 14. $287\frac{1}{2}$ by 12. |

EXERCISE 52

(INTRODUCTORY)

1. Compare $\frac{1}{2}$ of \$1 with $\frac{1}{2}$ of \$3.
2. By drawing a rectangle any size and finding $\frac{2}{3}$ of it, and then drawing another twice as long and of the same width, and taking $\frac{1}{3}$ of it, show that $\frac{2}{3}$ of 1 = $2 \div 3$.
3. Compare $\frac{2}{3}$ of one foot with $\frac{1}{3}$ of 2 ft.
4. Compare $\frac{1}{3}$ of an hour with $\frac{1}{3}$ of 4 hrs.
5. Show by means of lines that $\frac{5}{3} = 5 \div 3$.
6. By taking 15 as the unit, show that $\frac{2}{3}$ of 1 unit = 3 units $\div 3$.
7. By taking 24 as the unit, show that $\frac{2}{3} = \frac{1}{3}$ of 2 or $2 \div 3$.
8. What relation does a fraction indicate with reference to the numerator and denominator?
9. Multiply $\frac{4}{10}$ by $\frac{3}{7}$.

$$\frac{3}{7} = 3 \div 7.$$

$$3 \times \frac{4}{10} = 1\frac{2}{5}.$$

$$\frac{12}{10} \div 7 = 1\frac{2}{35}.$$

$$\therefore \frac{4}{10} \times \frac{3}{7} = \frac{12}{135} = \frac{4 \times 3}{10 \times 7} = \frac{\text{the product of the numerators}}{\text{the product of the denominators}}.$$

NOTE.—Cancel the factors common to the numerators and the denominators.

EXERCISE 53

Find the value of:

- | | | |
|---------------------------------|--|--|
| 1. $\frac{5}{8} \times 18$. | 5. $1\frac{3}{4} \times 1\frac{2}{5}$. | 9. $4\frac{5}{8} \times 5\frac{3}{8} \times 2\frac{1}{2}$. |
| 2. $\frac{5}{8} \times 45$. | 6. $1\frac{2}{5} \times 2\frac{5}{11} \times 7\frac{7}{8}$. | 10. $1\frac{1}{2} \times 2\frac{2}{5} \times 3\frac{1}{2}$. |
| 3. $\frac{5}{8} \times 45$. | 7. $\frac{5}{7} \times 1\frac{2}{3} \times 1\frac{1}{4}$. | 11. $1\frac{2}{5} \times 1\frac{1}{2} \times 2\frac{5}{8}$. |
| 4. $1\frac{7}{10} \times 124$. | 8. $1\frac{1}{2} \times 1\frac{3}{10} \times 1\frac{7}{8}$. | 12. $2\frac{1}{2} \times 3\frac{1}{2} \times \frac{1}{5}$. |

13. What should be paid for $\frac{1}{2}$ of $\frac{7}{8}$ of a pound of tea, at the rate of $1\frac{1}{2}$ of a dollar per pound?

14. What should be paid for $\frac{3}{4}$ of a barrel of apples, if the whole barrel is worth $1\frac{1}{2}$ of a dollar?

15. A has $\frac{3}{4}$ of \$375, B has $\frac{1}{4}$ as much, and C $\frac{1}{2}$ as much as both. How many dollars has each, and how many have they all?

EXERCISE 54

Example 1. Multiply $6\frac{2}{3}$ by $7\frac{1}{4}$.

$$7\frac{1}{4} = \frac{29}{4}, \text{ and } 6\frac{2}{3} = \frac{20}{3}.$$

$$\therefore 7\frac{1}{4} \times 6\frac{2}{3} = \frac{29}{4} \times \frac{20}{3} = \frac{1}{1} \times \frac{1}{1} = 52.$$

EXERCISE 55

Find the value of:

- | | | |
|---|---|--|
| 1. $3\frac{1}{2} \times 5\frac{7}{8}$. | 3. $17\frac{3}{4} \times 16\frac{3}{4}$. | 5. $5\frac{7}{8} \times 4\frac{3}{11} \times 77 \times 4\frac{1}{2}$. |
| 2. $6\frac{2}{3} \times 7\frac{7}{8}$. | 4. $39\frac{3}{4} \times 33\frac{1}{2}$. | 6. $3 \times 7\frac{1}{2} \times 1\frac{1}{2} \times 3\frac{3}{11}$. |

EXERCISE 56

1. Multiply the sum of $4\frac{1}{2}$ and $2\frac{1}{2}$ by the difference between $9\frac{1}{2}$ and $7\frac{1}{2}$.

2. When apples cost $\$3\frac{3}{4}$ per barrel, find the cost of $25\frac{1}{2}$ bbl.

3. Find the cost of $7\frac{1}{2}$ doz. eggs at 23c. per dozen.

4. Convert $2\frac{2}{5}$ of $\frac{5}{8} \times \frac{7}{8}$ into a simple fraction.

5. How much must be added to $1\frac{4}{5}$ of 186 to make $\frac{2}{3}$ of $\frac{1}{2}$ of 750?

6. Multiply the sum, difference, and product of $\frac{2}{3}$ and $\frac{1}{4}$ together.

7. Find the cost of $51\frac{1}{2}$ yd. of braid at $23\frac{1}{2}$ c. per yard.

8. A merchant sold three pieces of silk containing $17\frac{1}{2}$ yd., $13\frac{3}{4}$ yd., and $18\frac{1}{4}$ yd., respectively, at $\$1\frac{3}{4}$ per yard. How much did he receive for the silk?

9. How much more did $40\frac{1}{2}$ doz. eggs at $22\frac{1}{2}$ c. a dozen cost, than $56\frac{3}{4}$ lb. of beef at $12\frac{1}{2}$ c. per pound?

10. A left $\frac{2}{3}$ of his estate to his wife, $\frac{1}{3}$ of it to his daughter, and the remainder to his son. His son received $\$20900$. How much did the daughter receive?

11. Mr. Jones rented a house at $\$42\frac{3}{4}$ a month, taking a lease for 5 yr., but disposed of the lease at the end of $3\frac{1}{2}$ yr. How much rent did he pay?

12. A bill of books at retail amounts to $\$375\frac{5}{8}$, but I got a reduction of $\frac{1}{4}$ for wholesale and $\frac{2}{5}$ of what was then to be paid for cash. What was the exact amount of the bill?

13. On $\frac{2}{3}$ of my field I planted corn; on $\frac{2}{3}$ of the remainder I sowed wheat; on $\frac{2}{3}$ of the remainder I planted potatoes; the rest, consisting of $\frac{1}{3}$ of an acre, was planted in beans. How large was my field?

EXERCISE 57

Simplify:

1. $\frac{2}{3} \times (\frac{1}{4} + \frac{1}{6})$.

7. $(\frac{2}{3} + \frac{5}{6}) \times (\frac{5}{6} - \frac{1}{6})$.

2. $5 \times (7 - 2\frac{1}{2})$.

8. $\frac{1}{3} \times (\frac{2}{3} - \frac{1}{3}) + \frac{1}{4}$.

3. $(3\frac{3}{4} - 2\frac{1}{2}) \times 2\frac{1}{2}$.

9. $(2\frac{1}{2} + 3\frac{1}{2} - 4\frac{1}{2}) \times 12$.

4. $4\frac{1}{2} - \frac{1}{2}$ of $3\frac{1}{2}$.

10. $60 - (2\frac{1}{2} + 4\frac{3}{4}) \times 8$.

5. $(\frac{1}{2} - \frac{1}{4} + \frac{1}{6}) \times 24$.

11. $2\frac{1}{2} \times \frac{5}{6}$ of $\frac{1}{2}\frac{2}{3} - \frac{2}{30}$.

6. $(4\frac{1}{2} + \frac{1}{3} - 4\frac{5}{6}) \times 2\frac{3}{4}$.

12. $\frac{5}{6}$ of $1\frac{1}{2} + \frac{2}{3}$ of $4\frac{1}{2}$.

EXERCISE 58

INTRODUCTORY

1. Find the product of $\frac{1}{2}$ and $\frac{3}{4}$; of $\frac{1}{3}$ and $\frac{2}{5}$.
2. What is the product when a fraction is multiplied by another formed by inverting its terms?
3. State of the products when the following fractions are multiplied together: $\frac{1}{2}$ and $\frac{3}{4}$; $\frac{1}{3}$ and $\frac{2}{5}$; $\frac{1}{4}$ and $\frac{3}{5}$.
4. What is the effect upon the quotient of multiplying both dividend and divisor by the same number? Illustrate by dividing 24 by 6 and then multiplying both dividend and divisor by 2, by 3, by 4 before dividing.

5. When any quantity is divided by 1, what is the quotient? Illustrate by dividing 18 by 1; 20 by 1; $\frac{1}{2}$ by 1; $\frac{1}{3}$ by 1.

6. Divide $\frac{3}{4}$ by $\frac{1}{2}$.

$$\frac{3}{4} \div \frac{1}{2} = (\frac{3}{4} \times \frac{2}{1}) \div (\frac{1}{2} \times \frac{1}{2}).$$

$$= \frac{3}{2} \times \frac{2}{1} + 1.$$

$$= 1\frac{1}{2}.$$

- Dividend multiplied by divisor inverted.

EXERCISE 59

Divide:

- | | | |
|---------------------------|--|---|
| 1. 10 by $\frac{1}{2}$. | 5. $\frac{1}{2}$ by $\frac{1}{12}$. | 9. $9\frac{1}{2}$ by $\frac{1}{10}$. |
| 2. 18 by $\frac{1}{3}$. | 6. $\frac{1}{12}$ by $\frac{1}{10}$. | 10. $7\frac{5}{11}$ by $12\frac{3}{11}$. |
| 3. 30 by $\frac{1}{4}$. | 7. $1\frac{1}{2}$ by $\frac{1}{10}$. | 11. $21\frac{1}{2}$ by $12\frac{3}{11}$. |
| 4. 40 by $3\frac{1}{2}$. | 8. $1\frac{8}{10}$ by $1\frac{1}{2}$. | 12. $45\frac{1}{2}$ by $2\frac{1}{2}$. |

EXERCISE 60

1. A farmer sold $27\frac{1}{2}$ a. of land for \$1150. How much per acre did he receive?
2. If it takes $43\frac{1}{2}$ yd. of cloth to make 5 suits of clothes, how many yards will be needed to make 12 suits?

3. A pole 28 ft. high casts a shadow $64\frac{1}{10}$ ft. long. How long a shadow will a pole 15 ft. high cast at the same time?

4. If 21 a. of land yield $735\frac{1}{2}$ bu. of oats, how many bushels will 45 a. yield at the same rate?

5. A train goes $184\frac{1}{2}$ mi. in 6 hr. How far does it go in $1\frac{1}{2}$ hr.?

6. If 2 a. of land yield $75\frac{1}{2}$ bu. of barley, how many acres will be required to yield 210 bu. at the same rate?

7. How many pounds of butter at $21\frac{1}{2}$ c. per pound will pay for $45\frac{1}{2}$ lb. of tea at $37\frac{1}{2}$ c. per pound?

8. The cost of 30 t. of coal was $\$107.08\frac{1}{2}$. At what rate per cwt. must it be sold to gain $\frac{1}{2}$ of the cost?

9. A man's wages are $\$3\frac{1}{2}$ per day; his expenses are $\$1\frac{1}{2}$. How many days must he work to save $\$46\frac{1}{2}$?

10. Three-twentieths of a sum of money increased by $\$28$ is equal to $\frac{1}{10}$ of it. Find the sum of money.

11. Find the weight of water in a rectangular cistern $7\frac{1}{2}$ ft. long, $3\frac{3}{4}$ ft. wide, and $4\frac{1}{2}$ ft. deep.

12. Find a number which, divided by $5\frac{1}{2}$, the quotient increased by $2\frac{3}{4}$, and the sum multiplied by $5\frac{1}{2}$, the product is 36.

13. A man owning $\frac{3}{4}$ of a factory, sold $\frac{1}{4}$ of what he owned for $\$15750$. What was the factory worth?

EXERCISE 61

Simplify:

1. $(\frac{2}{3} + \frac{1}{10}) + (\frac{1}{5} - \frac{1}{3})$.

2. $7\frac{1}{2} + (\frac{2}{3} \text{ of } \frac{1}{4} + 1\frac{7}{10})$.

3. $\frac{3}{4} \text{ of } \frac{2}{3} + 4\frac{1}{2} + 7\frac{1}{2}$.

4. $\frac{1}{2} \text{ of } \frac{3}{4} + (1\frac{1}{2} + 1\frac{1}{4})$.

5. $(7\frac{2}{3} + 2\frac{1}{2}) \div (15\frac{5}{12} - 3\frac{1}{4})$.

6. $(2\frac{1}{2} - \frac{3}{8} + 1\frac{5}{12}) + \frac{3}{4}$.

7. $2\frac{1}{2} \times 3\frac{1}{2} - (5\frac{1}{2} + 2\frac{1}{2})$.

8. $(7\frac{2}{3} + 6\frac{1}{4}) \div (7\frac{1}{2} - 6\frac{3}{4})$.

9. $\frac{1}{8} + 1\frac{1}{2} + \frac{1}{4} \text{ of } \frac{5}{8}$.

10. $2\frac{1}{2} \times 3\frac{1}{2} \div 5\frac{1}{2} + 2\frac{1}{2}$.

11. $2\frac{1}{2} + 3\frac{1}{2} + 5\frac{1}{2} + 2\frac{1}{2}$.

12. $7\frac{1}{2} + 6\frac{3}{10} - 6\frac{2}{10} + 7\frac{1}{2}$.

EXERCISE 62

REVIEW

1. Find the greatest number that is exactly contained in 2800 and 3640.
2. Find the least number that will contain each of the numbers, 240, 260, 450, and 540 without a remainder.
3. By what number must $4\frac{1}{2}$ be divided to give a quotient $\frac{1}{2}$?
4. The divisor is $2\frac{1}{2}$; the quotient $5\frac{1}{2}$. Find the dividend.
5. If $3\frac{1}{2}$ bbl. of apples are worth \$12 $\frac{1}{2}$, find the value of $5\frac{1}{2}$ bbl.
6. Simplify $\frac{1}{2}$ of $\frac{1}{3} + \frac{1}{4}$ of $\frac{1}{5}$.
7. Express $\frac{1440}{1000}$ in its simplest form.
8. Divide the continued product of 16, 24, 32, 36 and 42 by the continued product of 27, 84, and 96 in the shortest way you can.
9. The divisor is 245; the quotient is 4 times the divisor, and the remainder is the largest possible. Find the dividend.
10. Simplify $3\frac{1}{2} \times 4\frac{1}{2} + 2\frac{1}{2}$.
11. *A* and *B* had \$1200 between them. *A* spent \$175 and *B* spent \$125; then *A* had twice as much as *B*. How much had each at first?
12. A merchant bought 640 bu. of wheat, part at 72c. per bushel and the remainder at 77c. The whole averaged 75c. per bushel. How many bushel of each kind did he buy?
13. Find the remainder after subtracting 457 as often as possible from ten thousand.
14. If 3 geese and 5 turkeys cost \$14.40 and 5 geese and 3 turkeys cost \$12, find the value of a goose.
15. How many minutes are there between 3 p.m. Feb. 27, 1904, and 7 a.m. March 22nd?

SECTION V. COMPLEX FRACTIONS

EXERCISE 63

INTRODUCTORY

1. Express the fourth of $2\frac{1}{2}$ in the form of a fraction. Name the numerator; name the denominator.

2. Indicate the division of 6 by $4\frac{2}{3}$ by using a fraction. Name the numerator; name the denominator.

3. Express the division of $3\frac{1}{2}$ by $5\frac{1}{4}$ in the form of a fraction. Name the numerator; name the denominator.

6. Fractions like $\frac{2\frac{1}{2}}{4}$, $\frac{6}{4\frac{2}{3}}$, or $\frac{3\frac{1}{2}}{5\frac{1}{4}}$ in which there is a fraction for numerator, or for denominator, or for both, are called *Complex Fractions*.

4. Write five complex fractions, and state why each is a complex fraction.

5. Why are $\frac{\frac{3}{4}}{5}$, $\frac{\frac{2}{3}}{2\frac{1}{4}}$, and $\frac{7}{\frac{1}{3}}$ complex fractions?

6. What operation does the complex fraction $\frac{2\frac{1}{2}}{3\frac{1}{4}}$ indicate?

7. Divide $2\frac{1}{2}$ by $3\frac{1}{4}$.

8. Express $\frac{4}{2\frac{1}{2}}$ as an example in division of fractions, and simplify it.

9. Express $\frac{6\frac{3}{4}}{10\frac{1}{2}}$ as an example in division of fractions and simplify it.

10. Simplify $5\frac{1}{4}$, $1\frac{1}{2}$, and also $\frac{5\frac{1}{4}}{1\frac{1}{2}}$.

11. Simplify $\frac{1}{3\frac{1}{4}}$ and $\frac{2\frac{1}{2}}{5}$.

12. What is the effect on the value of a fraction of multiplying both terms by the same number. Illustrate by expressing the following fractions in their simplest form:

$$\frac{1\frac{1}{2}}{2\frac{1}{2}}, \quad \frac{2\frac{1}{2}}{3\frac{1}{2}}, \quad \frac{4\frac{1}{2}}{5\frac{1}{2}}, \quad \frac{5\frac{1}{2}}{6\frac{1}{2}}, \quad \frac{4\frac{1}{2}}{6\frac{1}{2}}, \quad \frac{7\frac{1}{2}}{8\frac{1}{2}}.$$

13. Express in simple fractional form the following:

$$\frac{2\frac{1}{2}}{3\frac{1}{2}}, \quad \frac{4\frac{1}{2}}{5\frac{1}{2}}, \quad \frac{3\frac{1}{2}}{4\frac{1}{2}}, \quad \frac{7\frac{1}{2}}{8\frac{1}{2}}, \quad \frac{4\frac{1}{2}}{5\frac{1}{2}}, \quad \frac{6\frac{1}{2}}{7\frac{1}{2}}.$$

EXERCISE 64

Simplify:

- | | | |
|---|---|---|
| 1. $\frac{52}{3\frac{1}{2}}$ | 11. $\frac{23}{2\frac{1}{2} + \frac{1}{2}}$ | 20. $\frac{2\frac{1}{2} - 1\frac{1}{2}}{1\frac{1}{2} \text{ of } 1\frac{1}{2}}$ |
| 2. $\frac{5\frac{1}{2}}{5}$ | 12. $\frac{2\frac{1}{2} + 1\frac{1}{2}}{3\frac{1}{2} - 2\frac{1}{2}}$ | 21. $\frac{7\frac{1}{2} + 2\frac{1}{2}}{15\frac{1}{2} - 3\frac{1}{2}}$ |
| 3. $\frac{1\frac{1}{2}}{1\frac{1}{2}}$ | 13. $\frac{14\frac{1}{2} - 6\frac{1}{2}}{3\frac{1}{2} + 7\frac{1}{2}}$ | 22. $\frac{4\frac{1}{2} - 2\frac{1}{2}}{4\frac{1}{2} + 2\frac{1}{2}}$ |
| 4. $\frac{1\frac{1}{2}}{7\frac{1}{2}}$ | 14. $\frac{4\frac{1}{2} + 6\frac{1}{2}}{9\frac{1}{2} - 3\frac{1}{2}}$ | 23. $\frac{2\frac{1}{2} - \frac{1}{2}}{2\frac{1}{2} + \frac{1}{2}}$ |
| 5. $\frac{4\frac{1}{2}}{2\frac{1}{2}}$ | 15. $\frac{2\frac{1}{2} + 1\frac{1}{2}}{9\frac{1}{2} - 1\frac{1}{2}}$ | 24. $\frac{3\frac{1}{2} + 4\frac{1}{2}}{4\frac{1}{2} + 5\frac{1}{2}}$ |
| 6. $\frac{9\frac{1}{2}}{2\frac{1}{2}}$ | 16. $\frac{3\frac{1}{2} \text{ of } 1\frac{1}{2}}{1\frac{1}{2} \text{ of } 1\frac{1}{2}}$ | 25. $\frac{4\frac{1}{2} + 7\frac{1}{2}}{7\frac{1}{2} - 6\frac{1}{2}}$ |
| 7. $\frac{5\frac{1}{2}}{2\frac{1}{2}}$ | 17. $\frac{3\frac{1}{2} \text{ of } 2\frac{1}{2}}{\frac{1}{3} \text{ of } 8\frac{1}{2}}$ | 26. $\frac{2\frac{1}{2} \times 3\frac{1}{2}}{2\frac{1}{2} + 3\frac{1}{2}}$ |
| 8. $\frac{8\frac{1}{2}}{5\frac{1}{2}}$ | 18. $\frac{4\frac{1}{2} \text{ of } 2\frac{1}{2}}{5\frac{1}{2} - 4\frac{1}{2}}$ | 27. $\frac{\frac{1}{2} - \frac{1}{2}}{\frac{1}{2} + 1\frac{1}{2}}$ |
| 9. $\frac{15\frac{1}{2}}{7\frac{1}{2}}$ | 19. $\frac{2\frac{1}{2} + 2\frac{1}{2}}{5\frac{1}{2} \times \frac{1\frac{1}{2}}{3}}$ | 28. $\frac{20\frac{1}{2} - 10\frac{1}{2}}{20\frac{1}{2} + 10\frac{1}{2}}$ |
| 10. $\frac{9}{3\frac{1}{2}}$ | | |

EXERCISE 65

1. By what fraction must $\frac{1}{2}$ be divided to give a quotient $\frac{1}{3}$? Can more than one such fraction be found?

2. John had $\frac{1}{2}$ of a melon, and gave away $\frac{1}{3}$ of what he had. What part of the melon had he left?

3. A miller wishes to put 39 bu. of wheat into bags, each bag to hold $2\frac{1}{2}$ bu. How many bags would it require?

4. A man owned $\frac{3}{4}$ of a ship and sold $\frac{1}{4}$ of his share for \$5477. What was the whole ship worth?

5. If $7\frac{1}{2}$ lb. of coffee cost $187\frac{1}{2}$ c., what will a bag containing $63\frac{1}{2}$ lb. cost?

6. A man's wages are \$3 $\frac{1}{2}$ per day, and his daily expenses are \$1 $\frac{1}{2}$. How many days must he labor to enable him to buy a suit of clothes worth \$46 $\frac{1}{2}$?

7. Arrange the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ of $\frac{1}{6}$, in ascending order of magnitude.

8. If \$2 $\frac{1}{2}$ will pay a woman's wages for $2\frac{1}{2}$ days, how much will pay for $5\frac{1}{2}$ days' work?

9. James by mistake subtracted $\frac{1}{2}$ instead of $\frac{1}{3}$. Was his answer too large or too small, and how much?

10. I bought $7\frac{1}{2}$ thousand feet of boards for \$135.80. At the same rate, what would $19\frac{1}{2}$ thousand feet cost?

11. I paid \$788.30 for $83\frac{1}{2}$ a. of land. What would 7 a. cost at the same rate?

12. What is the least number that must be taken from 60 so that it may be exactly divisible by $7\frac{1}{2}$?

EXERCISE 66

INTRODUCTORY

1. *A* can dig a garden in 2 da. Draw a diagram of the garden, and show the part he can dig in 1 da.
2. Show by a diagram the part *A*, who can do a piece of work in 4 da., can do in 1 da.
3. Show by a diagram the part of a piece of work *A* could do in 1 da., if he can do all of it in 6 da.
4. *A* can do $\frac{1}{2}$ a piece of work in 1 da. How long will it take him to do the whole of it?
5. *A* can do $\frac{1}{3}$ of a piece of work in 1 day. How long will it take him to do the whole of it?
6. *A* can do $\frac{2}{3}$ of a piece of work in 1 day. How long will it take him to do the whole of it?
 Time to do $\frac{2}{3}$ of work = 1 da.
 " " $\frac{1}{3}$ " = $\frac{1}{2}$ "
 " " $\frac{1}{3}$ " = $3 \times \frac{1}{2}$ da. = $1\frac{1}{2}$ da.
7. *A* can do a piece of work in 5 days which *B* can do in 4 days. How much of the work can they together do in 1 day?
8. *A* can do a piece of work in 4 days; *B* can do it in 6 days. If both work together, in what time will it be done?
9. *A*'s working power is $\frac{1}{2}$ of *B*'s. How long will it require *B* to do a work which *A* can do in 6 days?
10. *A*'s working power is $\frac{2}{3}$ of *B*'s. How long will it require *B* to do a work which *A* can do in 12 days?
11. *A*'s working power is $\frac{3}{4}$ of *B*'s. How long will it require *A* to do a work which *B* can do in 12 days?
12. *A* can do a piece of work in 8 days, and *B* can do it in 9 days. How long will it require *A* and *B* working together to do it?

The part A does daily $= \frac{1}{8}$ of the work.

" " B " " $= \frac{1}{6}$ " " "

" " A and B do daily $= \frac{1}{8} + \frac{1}{6} = \frac{7}{24}$ of the work.

\therefore They do $\frac{7}{24}$ of the work in $\frac{24}{7}$ da.;

They do the whole work in $4\frac{4}{7}$ da. or $4\frac{4}{7}$ da.

EXERCISE 67

1. A can do a piece of work in 12 hr., and B can do it in 15 hr. In what time can both working together do the work?

2. A can do a piece of work in 20 days, B can do it in 24 days, and C can do it in 30 days. In what time will they all do it working together?

3. A can build a wall in 8 days, B in 12 days, and C in 15 days. In what time can they all build it working together?

4. A quantity of flour lasts a man and wife 9 days, and the wife alone 27 days. How long would it last the man alone?

5. A can do a piece of work in 20 days; after working at it for 8 days, B comes to help him, and they finish the work in 5 days. How long would it take B by himself to do the work?

6. A cistern has three pipes; the first will fill it in 10 hr., the second in 12 hr., and the third in 15 hr. In what time will they together fill the cistern?

7. A , whose working capacity is $\frac{1}{2}$ B 's, can mow a piece of grass in 4 days. If both A and B work together, in what time will they do the work?

8. A can do $\frac{2}{3}$ of a piece of work in 8 days; B can do $\frac{1}{3}$ of the same work in 12 days. In what time could both working together do two such pieces of work?

9. A boy can do a piece of work in $4\frac{1}{2}$ days and a man can do the same in $\frac{1}{4}$ of the time. How many days will both working together require to do five times the amount of work?

10. A and B can mow a field in 12 days; A and C in 15 days; B and C in 20 days. In what time could A mow it by himself?

20-2-6

11. A and B can do a piece of work in 8 days; A and C can do it in 9 days, and B and C in 10 days. In what time can all three working together do it?

12. A and C can dig a garden in 10 days; B and C can dig $\frac{1}{3}$ of the same garden in 4 days, and B alone can dig it in 20 days. In what time can A do it by himself? 16 d.

13. A and B can do a piece of work in 20 days; B and C can do it in 24 days. In what time can each do it by himself, provided B 's working power is $\frac{1}{3}$ of A 's? $A. 36$
 $B. 45$
 $C. 50$

14. A 's working power is $\frac{1}{3}$ of B 's and B 's is $\frac{1}{3}$ of C 's. In what time will all three working together do a piece of work which B by himself can do in 15 days?

5 days

VI. G.C.M. AND L.C.M. OF FRACTIONS

INTRODUCTORY

EXERCISE 68

- Find the G.C.M. of 20s. and 28s.
- Find the G.C.M. of £1 and £1 8s.
- Find the G.C.M. of 12 twenty-fifths and 16 twenty-fifths.
- Change $\frac{1}{3}$ and $\frac{2}{3}$ into equivalent fractions with the least common denominator, and find their G.C.M.
- Change $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$ into their equivalents with the least common denominator and find their G.C.M.
- State the steps in finding the G.C.M. of two or more fractions.

7. Find the L.C.M. of 12d. and 16d.
8. Find the L.C.M. of 1s. and 1s. 4d.
9. Find the L.C.M. of $\frac{2}{3}$, $\frac{1}{4}$, and $\frac{1}{6}$.
10. Change $\frac{7}{8}$, $\frac{1}{4}$, and $\frac{2}{3}$ into their equivalents with the least common denominator, and find their L.C.M.
11. Change 4, $2\frac{2}{3}$, and $2\frac{1}{2}$ into equivalent fractions with the least common denominator, and find their L.C.M.
12. State the steps in finding the L.C.M. of two or more fractions.

EXERCISE 69

Find the G.C.M. and L.C.M. of the following fractions:

- | | | |
|--|--|---|
| 1. $\frac{2}{3}$, $\frac{5}{6}$, $\frac{7}{12}$. | 3. $\frac{2}{3}$, $\frac{7}{8}$, $\frac{5}{12}$. | 5. $2\frac{1}{2}$, $3\frac{1}{4}$, $4\frac{1}{2}$. |
| 2. $\frac{2}{3}$, $\frac{5}{12}$, $\frac{8}{21}$. | 4. $\frac{5}{6}$, $\frac{10}{12}$, $\frac{15}{14}$. | 6. 3, $4\frac{1}{2}$, $5\frac{1}{2}$. |

7. The three sides of a triangular field are $134\frac{1}{2}$ yd., $128\frac{1}{2}$ yd., and $115\frac{1}{2}$ yd. long respectively. What is the longest string that can be used to measure each side?

8. How many times is the G.C.M. of $\frac{2}{10}$, $\frac{1}{12}$, and $\frac{1}{100}$ contained in their L.C.M.?

9. A, B, and C start at the same time and place to travel round an island, A making the circuit in $4\frac{1}{2}$ hr., B in $5\frac{2}{3}$ hr., and C in $3\frac{5}{12}$ hr. In how many hours will they be together at the starting point, and how many times will each have gone round the island?

VII. DENOMINATE FRACTIONS

EXERCISE 70

1. What is the primary unit in $\frac{3}{4}$ yd.? In $\frac{1}{4}$ s.? In $\frac{1}{4}$ a.?

7. A fraction in which the *primary unit is a denominate number*, is said to be a *Denominate Fraction*.

2. Give five examples of denominate fractions.

3. Reduce 3 ft. to inches and find the number of inches in $\frac{3}{4}$ ft.

4. Compare $\frac{3}{4}$ of 1 ft. with $\frac{1}{4}$ of 3 ft.

5. Find $\frac{1}{8}$ of 2 hr. and compare this with $\frac{3}{8}$ of 1 hr.

Example 1. How many shillings, etc., are there in $\frac{3}{8}$ of a pound?

$$\begin{array}{r} \text{£} \quad \text{s.} \quad \text{d.} \\ 8)3 \quad 0 \quad 0 \\ \hline \quad \quad 7 \quad 6 \end{array}$$

Since $\text{£}\frac{3}{8} = \frac{1}{3}$ of $\text{£}3$, we divide $\text{£}3$ by 8 as in compound division.

Example 2. Find the value of $3\frac{1}{2}$ of $\frac{1}{15}$ of 2 t. 3 cwt.

$3\frac{1}{2}$ of $\frac{1}{15}$ of 2 t. 3 cwt. = $\frac{13}{4}$ of $\frac{1}{15}$ of 2 t. 3 cwt.

= $\frac{3}{4}$ of 2 t. 3 cwt.

= $\frac{6 \text{ t. } 9 \text{ cwt.}}{4} = 1 \text{ t. } 12 \text{ cwt. } 25 \text{ lb.}$

What is the value:

- 3 pt. 1 qt. $1\frac{1}{2}$ pk. 1. Of $\frac{1}{8}$ of a bushel? 7. Of $\frac{1}{10}$ of a mile? 96 rods
 23 x. 1 yd. 2' 6" 2. Of $\frac{2}{3}$ of a mile? 8. Of $\frac{1}{7}$ of a ton? 1750 lbs
 4 yd. 2' 5' $\frac{1}{4}$ " 3. Of $\frac{1}{8}$ of a rod? 9. Of $\frac{5}{8}$ of an acre? 800 sq. yd. 26
 4 d. 23 hr. 28 min 4. Of $\frac{3}{7}$ of $\text{£}3$ 16s. 8 $\frac{1}{2}$ d.? Of $\text{£}18$ 16s. 7 $\frac{1}{2}$ d. + 3 $\frac{1}{2}$? 34 yd. 8 sq. ft.
 1 pt. 7 $\frac{5}{8}$ oz. 5. Of $\frac{3}{8}$ of a week + $\frac{1}{4}$ of a day + $\frac{1}{2}$ of an hour?
 6. Of $\frac{11}{100}$ cwt. - $\frac{1}{15}$ of 2 lb. 8 oz.?

EXERCISE 71

INTRODUCTORY

- \$1 is what part of \$4? Of \$5? Of \$7? Of \$10?
- \$3 is what part of \$4? Of \$5? Of \$7? Of \$10?
- What part of a foot is 1 in.? Is 2 in.? Is 3 in.? Is 4 in.?

4. Reduce 1 yd. and 1 ft. 5 in. each to inches, and find what part the latter is of the former.

5. Express 1s. 4d. and $\text{£}2$ 4s. each as pence, and find what fraction the former is of the latter.

6. Reduce 2 t. 4 cwt. and 2 t. 50 lb. each to pounds, and find what fraction the latter is of the former.

Example 3. Express 4 rd. 2 yd. 1 ft. 4 in. as the fraction of 1 mile.

4 rd. 2 yd. 1 ft. 4 in. = 880 in. and 1 m. = 63360 in.

Now 1 in. = $\frac{1}{63360}$ of 63360 in.;

\therefore 880 in. = $\frac{880}{63360}$ of 63360 in.

Hence, the fraction required is $\frac{880}{63360}$, or $\frac{1}{72}$.

7. Before expressing one denominate number as the fraction of another, in what denomination must the numbers be expressed?

8. State the steps in finding what fraction one denominate number is of another.

9. What fraction is 2 ft. 3 in. of 5 yd.?

10. What fraction of 2 hr. 10 min. is 1 hr. 30 min.?

11. If the unit of measurement is 3 ft. 4 in., what is the measure of 10 ft.? Of 6 ft. 8 in.? Of 1 ft. 8 in.? Of 10 in.?

NOTE.—The example, *Express 4 lb. as the fraction of 8 lb.*, may be written in any of the following ways:

1. Reduce 4 lb. to the fraction of 8 lb.

2. What fraction of 8 lb. is 4 lb.?

3. What part of 8 lb. is 4 lb.?

4. If 8 lb. is the unit, what is the measure of 4 lb.?

EXERCISE 72

1. What part of an ounce is $\frac{3}{16}$ of a scruple?
2. What part of a ton is $\frac{4}{5}$ of an ounce?
3. What part of a mile is $\frac{8}{9}$ of a rod?
4. What part of an acre is $\frac{2}{3}$ of a square foot?
5. Reduce $\frac{8}{9}$ of a pint to the fraction of a gallon.
6. Reduce $\frac{4}{5}$ of an inch to the fraction of a rod.
7. Reduce $\frac{1}{8}$ of a pound to the fraction of a ton.
8. ~~What fraction of £3 2s. 6½d. is 14s. 10½d.?~~
9. ~~Express 13s. 10½d. as a fraction of £2 0s. 7d.~~
10. Express 2 a. 41 per. as a fraction of 4 a. 97 per.
11. Reduce $\frac{3}{22100}$ of a ton to the fraction of an ounce.
12. Reduce $\frac{1}{15120}$ of a mile to the fraction of an inch.

VIII. GENERAL REVIEW

EXERCISE 73

1. What is the value of a silver pitcher weighing 2 lb. 10 oz. Avoirdupois, at \$2.24 per ounce Troy?
2. How many pounds of gold are actually as heavy as 10 lb. of iron?
3. If a druggist buys 25 lb. Avoirdupois of drugs at \$8½ a pound, and sells them in prescriptions at 75c. an ounce Apothecaries' weight, what is the gain?
4. How many sovereigns will weigh an ounce Avoirdupois, if 1869 weigh 40 lb. Troy?
5. If ¾ of an inch on a map corresponds to 7 mi. of a country, what distance on the map represents 20 mi.?
6. The value of 1 lb. Troy of standard gold is £46 14s. 6d. Calculate the value of a vase of the same material, whose weight is 39 oz. 18 dwt.
7. If 31 cwt. of cheese cost £69 4s. 8d., what will 15 cwt. 50 lb. cost?
8. Bought 2 oz. of tea for 7½d. What is that per pound?
9. If 99 lb. cost £4 16s. 8d., how much is that per pound?
10. If, when flour is \$5 a barrel, the five-cent loaf of bread weighs 10 oz., what ought to be the weight when flour is \$8 a barrel?
11. If 1½ a. of land sell for \$34.50, what will 20 a. 90 per. cost at the same rate? $\$567.62\frac{1}{2}$
12. If 18 a. 140 per. cost \$900, what will 150 a. cost at the same rate? $\$7152\frac{48}{131}$
13. If 1½ bu. of wheat cost \$1.68½, what will 154 bu. 1 pk. 6 qf. cost? $\$173.74$
14. If a train travels 300 mi. in 9 hr 40 min., how long will it be in travelling 223 mi.? $7h. 11m. 8s.$

15. If 7 gal. 1 qt. of wine cost \$17.40, what will 3 qt. 1 pt. cost at the same rate?

16. If 15 yd., $\frac{3}{4}$ of a yard wide, will make a dress, how many yards, $\frac{5}{8}$ of a yard wide, will make another dress of the same size?

17. How many yards of cloth, $\frac{3}{4}$ yd. wide, will be required to line 35 yd., $1\frac{1}{4}$ yd. wide?

18. If it requires 36 yd. of carpeting, $\frac{3}{4}$ yd. wide, to cover a floor, how many yards, $\frac{7}{8}$ yd. wide, will be required to cover the same floor?

19. A regiment of 1000 men are to have new coats; each coat is to contain $2\frac{1}{2}$ yd. of cloth, $1\frac{1}{4}$ yd. wide, and to be lined with shalloon $\frac{3}{4}$ yd. wide. How many yards of shalloon will be required?

20. A bankrupt owes \$4000, and his assets—that is, his whole property—amount to only \$840. What dividend will his creditors receive in the dollar?

21. A merchant became insolvent, owing \$6850, and had only \$4932 with which to pay his creditors. How much should a creditor, whose claim is \$1540, receive?

22. What does a bankrupt pay in the pound if his creditors receive £376 5s. out of £2076?

23. How much will a creditor lose on a debt of \$5342.25 if he receives only $67\frac{1}{2}$ c. in the dollar?

24. A creditor loses $37\frac{1}{2}$ c. in the dollar of what was due to him, and thereby loses \$330. What was the sum due?

25. The divisor is $3\frac{3}{8} + 3\frac{6}{7}$ and the quotient $\frac{\frac{1}{4} - \frac{1}{8}}{\frac{1}{8} \text{ of } \frac{1}{16}}$. Find the dividend.

26. A receives $\frac{3\frac{1}{8}}{7\frac{1}{2}}$ of an estate and B $\frac{1}{8}$ of $\frac{1}{3}\frac{2}{3}$ of the remainder. C gets what is left and finds that his share is worth \$872 more than A's. What is the value of the estate?

27. A farmer sold a load of four-foot wood, 7 ft. long by 4 ft. high, to a grocer, at the rate of \$3.60 per cord, receiving in exchange 3 lb. tea at $37\frac{1}{2}$ c. per pound; 5 lb. rice at $5\frac{1}{2}$ c. per pound; and the remainder of the price in granulated sugar at the rate of 22 lb. for one dollar. How many pounds of sugar did he receive?

28. Find the weight of 500000 bricks at 4 lb. 2 oz. each, and the cost in dollars and cents, at 27s. 6d. per 1000, allowing 4s. 2d. to make a dollar.

29. A man bought a quantity of tea supposed to be done up in packages of 1 lb. each, for which he was to pay \$64; on weighing them, however, it was found that each package was 1 oz. light. How much should he pay for the tea?

30. A farmer exchanges $3\frac{1}{2}$ tons of wheat at $64\frac{1}{2}$ c. a bushel for coal at \$6.75 per ton. How many pounds of coal does he get?

31. Express, as a fraction of an acre, the sum of the following:— $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of an acre; $\frac{2}{3}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of 100 sq. rd.; and $\frac{1}{4}$ of $2\frac{1}{2}$ times 605 sq. yd.

32. A produce merchant exchanged $43\frac{1}{2}$ bu. of oats at $39\frac{1}{2}$ c. per bushel, and $13\frac{1}{2}$ bbl. of apples at \$3.85 per barrel, for butter at $37\frac{1}{2}$ c. per pound. How many pounds of butter did he receive?

33. The circumference of a wheel is $\frac{2}{3}$ of its diameter. Find the diameter of a wagon wheel which makes 30 revolutions in going a mile.

34. An orchard is $24\frac{1}{2}$ rd. long and $15\frac{1}{2}$ rd. wide. At $1\frac{1}{2}$ c. per cubic foot what will it cost to dig a ditch around the outside of it, 3 ft. 9 in. wide and 4 ft. deep?

35. A man spent $\frac{4}{5}$ of his money for a house, $\frac{1}{5}$ of the remainder for cattle, and the rest for a farm. If the farm cost him \$357 less than the house and cattle together, what did he pay for all?

36. A house and lot are together worth \$2100; $\frac{1}{4}$ of the value of the house is equal to $\frac{1}{3}$ of the value of the lot. Find the value of each.

37. Reduce to its simplest form $\frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{6} + \frac{1}{4}} \times \frac{\frac{1}{3} + \frac{1}{4}}{\frac{1}{8} \text{ of } 2\frac{1}{4}}$

38. Simplify

$$\frac{\frac{1}{4} - (\frac{1}{2} \text{ of } \frac{1}{2})}{\frac{1}{6} + (\frac{1}{3} \text{ of } 3\frac{1}{2}) - (\frac{1}{2} \text{ of } 1\frac{1}{2}) - \frac{1}{4}} + \frac{(\frac{1}{2} \text{ of } \frac{1}{2}) + (1\frac{1}{2} \text{ of } 5)}{9\frac{1}{2} - 1\frac{1}{2}}$$

39. A person sold $A \frac{1}{4}$ of his land, $B \frac{1}{3}$ of the remainder, $C \frac{1}{5}$ of what then remained, and received \$50 for what he had left at \$60 per acre. Find the number of acres he had at first.

40. Divide the sum of $\frac{1}{2}$ of $8\frac{1}{2}$ and $2\frac{1}{2}$ of $5\frac{1}{2}$ by the difference between $\frac{1}{3}$ of $3\frac{1}{2}$ and $\frac{1}{2}$ of $\frac{1}{2}$ of $2\frac{1}{2}$.

41. What quantity taken from $159\frac{1}{2}$ will make it exactly divisible by $12\frac{1}{2}$?

42. Simplify $\frac{1}{2} - \frac{1}{3}$ of $\frac{1}{4} + \frac{1}{8}$, and find how many times the result is contained in $\frac{1}{3} + (\frac{1}{2} \text{ of } \frac{1}{4} - \frac{1}{8})$.

43. Two men start from the same point at the same time to walk in the same direction around a block of land $1\frac{1}{2}$ mi. on each side. A goes at the rate of 4 mi. and B 3 mi. an hour. How far will A walk before he overtakes B ?

44. If $3\frac{1}{2}$ yd. of cloth cost \$12.50, what will $23\frac{1}{2}$ yd. cost?

45. Simplify $\frac{\text{£}14 \text{ 12s. 11d.}}{10\frac{1}{2} - 3\frac{1}{2}} \times \frac{\text{£}10 \text{ 10s. 10d.}}{10\text{s. } 9\frac{1}{2}\text{d.}}$

46. A grain dealer bought 64 bags of oats, weighing (including bags) 3616 lb. The bags averaged 1 lb. 12 oz. each. The dealer paid 34c. per bushel for the oats and sold them at 42 $\frac{1}{2}$ c. per bushel. How much was his gain?

47. A man owns $\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{1}{10}$ of an investment; on selling $\frac{1}{4}$ of his share he finds his interest worth \$100 less than before. What is the value of the whole investment?

48. I buy a farm containing 80 a., and sell $\frac{1}{4}$ of it for $\frac{1}{2}$ of the cost of the farm. I then sell the remainder at \$60 per acre, and neither gain nor lose by the whole transaction. Find the cost of the farm.

49. Change $\frac{1}{15}$ of $\frac{1}{2} + \frac{\frac{1}{2}}{3 + \frac{1}{4}}$ to a simple fraction.

50. Simplify:

$$(a) \frac{(3\frac{1}{2} - \frac{2}{11}) \text{ of } 6\frac{5}{11}}{\frac{1}{10} - \frac{1}{11} \text{ of } 12\frac{1}{2}} + (6\frac{1}{2} - 1\frac{1}{2})$$

$$(b) \frac{\frac{3}{10} \text{ of a guinea} - \frac{2}{15} \text{ of a } \pounds}{8s. 10\frac{1}{2}d.}$$

51. Reduce 2 hr. 20 min. to the fraction of $3\frac{1}{2}$ weeks.

52. A brick wall is to be built 90 ft. long, 17 ft. high, and 4 ft. thick. Each brick is 9 in. long, $4\frac{1}{2}$ in. wide, and $2\frac{1}{2}$ in. thick. How many bricks will be required?

53. How many boxes, each holding $\frac{3}{4}$ of a quart, will be required to hold 12 bu. 3 pk. 1 gal. 2 qt. of strawberries?

54. How many acres in the form of a square can be enclosed by a fence 144 rd. long?

55. A man does $\frac{3}{4}$ of a piece of work in one day. How long will it take him to do a piece of work $3\frac{1}{2}$ times as large as the first?

56. What length of carpet, 27 in. wide, will cover a rectangular floor $10\frac{1}{2}$ ft. by $15\frac{1}{2}$ ft.?

57. Express the fraction $\frac{1}{2}$ as one with 4 for numerator; $\frac{2}{3}$ as one with $7\frac{1}{2}$ for its numerator; $\frac{1}{4}$ as one with 20 for its denominator; and find one-third of the sum of the three.

58. Express £7 15s. 10d. in Canadian money.

59. At an election, where only five-sixths of the whole number of voters voted, one of the two candidates received half as many votes again as the other, and beat him by 795 votes. What was the whole number of votes?

60. Gunpowder is composed of $\frac{1}{10}$ sulphur, $\frac{2}{10}$ charcoal, and $\frac{3}{10}$ nitre. How many pounds of each will be required to make $1\frac{1}{2}$ t. of gunpowder?

61. A farmer sells to a merchant 3015 lb. of hay at \$16 per ton, and takes in payment 6 lb. of tea at 80c. per pound, $22\frac{1}{2}$ lb. of coffee at 26c. per pound, 33 lb. of sugar at 12 lb. for a dollar, $32\frac{1}{2}$ lb. of raisins at $18\frac{1}{2}$ c. per pound, 14 lb. 13 oz. of bacon at 16c. per pound, and the balance in cash. How much cash does the farmer receive?

62. Make a bill of the following entries:—James Anderson bought of Geo. Ritchie & Co., Jan. 13, 1914, $14\frac{1}{2}$ yd. of dress goods at 65c. per yard, $3\frac{1}{2}$ yd. of linen at 36c. per yard, $4\frac{1}{2}$ yd. of lining at 15c. per yard; Jan. 17, 18 pearl buttons at 24c. per dozen, 3 spools of thread at 5c. each; Jan. 26, $8\frac{1}{2}$ yd. of tweed at 72c. per yard, 16 yd. of cotton at $12\frac{1}{2}$ c. per yard, 15 yd. of cloth at 45c. per yard.

63. Farmer B sold to a merchant the following articles to apply on an overdue account of \$54.45:—1680 lb. of hay at \$15 per ton, $3\frac{3}{4}$ cords of wood at \$4.80 per cord, 4 bbl. of apples at \$2.75 per barrel, 350 lb. of flour at \$2.50 per cwt., 30 lb. 10 oz. of butter at 16c. per pound. Make out the account neatly, showing the balance, and to whom due.

64. Make a bill of the following items:—Mrs. Hay bought of Brown Bros., July 5, 1914, 8 lb. 8 oz. of currants at 8c. per pound, 25 lb. of rice at \$5 per cwt., 9 bars of soap at 3 for 25c.; July 19, 43 yd. of cotton at 7c. per yard, 16 yd. of dress goods at 29c. per yard, $\frac{1}{2}$ doz. spools at 3 for 10c.; July 29, paid cash on account \$5 and bought 3 qt. of maple syrup at \$1.20 per gallon, and paid the balance in cash on Aug 9.

65. Make out the following account, neatly and accurately, in proper form:—Nicholas Nickleby bought the goods from you on March 3, and paid you \$10 on account April 8, $3\frac{1}{2}$ lb. tea at 80c., 300 lb. sugar at $4\frac{1}{2}$ c. 45 yd. print at $11\frac{1}{2}$ c., $2\frac{1}{2}$ gal. syrup at 65c., 12 yd. towelling at $12\frac{1}{2}$ c., $\frac{1}{2}$ doz. knives and forks at \$2.50, 27 lb. cheese at 15c., 1 lb. 10 oz. lemon peel at 32c. per pound.

66. Make out in proper form and find the amount of the following bill:—June 1, 1914, G. Murray & Co. sold to John Scott, Toronto, 4886 bu. 36 lb. wheat at 58c. a bushel, 4530 lb. peas at 52c. a bushel, 38 bu. 3 pk. barley at 54c. a bushel, 465 lb. of flour at \$1.50 a cwt., 4685 lb. bran at \$15 a ton. Write out a receipt in full payment of account, 26th June.

CHAPTER IV

DECIMALS

I. NOTATION AND NUMERATION

EXERCISE 74

INTRODUCTORY

1. In the number 12345.678, name the place occupied by each digit.
2. How are tens related to units; units to tens?
3. How are hundreds related to tens; tens to hundreds?
4. How are thousands related to hundreds; hundreds to thousands?
5. What relation do tenths bear to units; units to tenths?
6. What relation do hundredths bear to tenths; tenths to hundredths?
7. What relation do thousandths bear to hundredths; hundredths to thousandths?

TABLE								
Thousands.	Hundreds.	Tens.	Units.	.	Tenths.	Hundredths.	Thousandths.	Ten-Thousandths.
2	2	2	2	.	2	2	2	2
3	3	3	3	.	3	3	3	3
4	4	4	4	.	4	4	4	4
5	5	5	5	.	5	5	5	5

8. Express the following as decimals:—The tenth of a unit; the tenth of a tenth; the tenth of a hundredth; the tenth of a thousandth; the tenth of a ten-thousandth; the tenth of a hundred-thousandth.

9. In the number 1234567.654321, compare the position of tens and tenths with reference to the units; of hundreds and hundredths; of thousands and thousandths.

14 - 3 -

10. The places to the right of units have, thus, corresponding names to those to the left, viz., tenths, hundredths, thousandths, ten-thousandths, hundred-thousandths, millionths, ten-millionths, etc.

11. Divide the number 123456789.456123 into periods of three figures each, counting from the point.

(a) Name the periods to the left of the decimal point.

(b) Read the first period to the right of the point.

(c) Compare, with reference to the units' period, the position of this period with that of thousands.

(d) Read the second period to the right of the point and compare the position of the millions and millionth periods with reference to the units' one.

12. Express as tenths:—7.2; 8.4; 6.5; 9.7.

13. Express as hundredths:—7.24; 8.35; .27; .07.

14. Express as thousandths:—.465; 7.25; .075; 8.1.

15. Read the following:—84.96; 364.072; 28.307; 17.008.

16. Express the following as decimals:— $\frac{7}{10}$; $\frac{8}{100}$; $\frac{27}{100}$; $6\frac{3}{10}$; $\frac{78}{1000}$; $8\frac{29}{100}$; $7\frac{8}{1000}$.

17. Read the following:—707005; 70700.5; 7070.05; 707.005; 70.7005.

18. Read the following:—6; 60; 600; 6000. From this state the effect of affixing ciphers to whole numbers.

19. Read the following:—4; .04; .004; .0004. From this state the effect of the ciphers.

20. Read the following:—.4; .40; .400; .4000. From this state the effect of the ciphers.

EXERCISE 75

Write the following decimals in words:

- | | | |
|----------|------------|---------------|
| 1. .9. | 5. 4.31. | 9. 21.3601. |
| 2. .27. | 6. 7.216. | 10. 17.0064. |
| 3. .368. | 7. 3.314. | 11. 18.00081. |
| 4. .064. | 8. 5.8167. | 12. 20.01458. |

Express in figures the following:

13. Eight tenths; two and seven hundredths; nine thousandths.

14. Eight hundred and seven, and ninety-four thousandths; three thousand and seventeen, and seven hundred and nine ten-thousandths; three, and one thousand and eight millionths.

15. Six, and four ten-thousandths; eighty, and six hundred and nine ten-millionths; one hundred and one, and one thousand and one hundred-thousandths.

II. ADDITION OF DECIMALS

EXERCISE 76

1. What kind of numbers can be added together?
2. In addition, how are the addends written so that units of the same order may be added together?
3. In $3.4+71.61+7.984+.689+367.8$, arrange the addends under one another so that units may be under units, tens under tens, tenths under tenths, etc.

Find the sum of the following:

(4)	(5)	(6)	(7)
42.3	12.326	4031.06	.608242
13.06	204.00	108.304	.0315044
8.049	8.3024	9.001345	.8034
1.6	52.007	76.739	.086
.037	324.1	250.0007	.9106

Find the sum of the following:—

8. $4.5 + 70.63 + 1.079 + 25$.
9. $.126 + 3.05 + .07 + .528 + 7.093$.
10. $111.306 + .0317 + 2.793 + .007$.
11. $470.05 + 72.701 + 3.0315 + 413.2658$.
12. $12.3987 + 4.1462 + .02063 + 13 + 10.962$.
13. $210.7 + 14563.21 + .0173 + 382.74156$.
14. $9.127 + 17.72 + .0041 + 2.31 + 170.96$.
15. $.101285 + 17.061 + 3.2001 + 5.38706$.
16. $2.325 + .0012 + 5.086 + 219.6832 + .407$.

EXERCISE 77

1. A man sold 36.75 a. of land, and then had 127.5 a. How many acres had he at first?
2. Add together fifty-nine tenths; six hundred, and seven hundredths; eighteen thousandths; seven, and eight ten-thousandths; and fifty, and five hundredths.
3. In one field there are 12.9 a.; in a second 14.75 a.; in a third 15.675 a.; in a fourth 17.865 a. How many acres are there in the four fields?
4. Five loads of coal weighed as follows:—1.75 t., 1.345 t., 1.5 t., 1.975 t., 2.25 t. How much did the five loads weigh?
5. A merchant bought 147.5 yd. of cloth at one time; 375.25 at another; and 453.125 at a third. How much cloth did he buy?

6. On Monday a bicyclist rode 47.245 mi.; on Tuesday, 50.64 mi.; on Wednesday, 56.5 mi.; on Thursday, 8.75 mi. How far did he ride these four days?

7. Find the sum of 407 thousandths, 75 millionths, 813 tenths, 6845 hundredths, and 75 ten-thousandths.

8. Simplify $351.76 + 30.09 + .007 + 90.65 + 17.7943$.

9. Six marble blocks weigh, respectively, 5.73 cwt., 4.834 cwt., 7.938 cwt., 7.4 cwt., 18 cwt., and 78.1 cwt. Find their total weight.

10. A train ran 45.7 mi. in the first hour, 51.74 mi. in the second, 50.7504 in the third, and 53.7105 in the fourth. How many miles did the train run during these four hours?

11. A merchant has four pieces of calico measuring, respectively, 25.5 yd., 29.125 yd., 34.25 yd., and 33.75 yd. How many yards are there in the four pieces?

12. Four fields contain as follows:—15.375 a., 12.6125 a., 14.008 a., 16.5 a. How many acres do the four fields contain?

III. SUBTRACTION OF DECIMALS

EXERCISE 71

1. Arrange the number 7.56 under 84.25, so that it may be taken from the latter.

2. The minuend is 96; the subtrahend is 2.75. Arrange these for subtraction, so that units of the same order may be under each other.

	(3)	(4)	(5)	(6)
From	18.5	2.8706	.50376	.36
Take	2.3476	.49	.065	.12704
	<hr/>	<hr/>	<hr/>	<hr/>

From

- | | |
|----------------------|------------------------|
| 7. 1.869 take .0374. | 11. 204.1 take 36.002. |
| 8. .0061 " .00089. | 12. 1000 " 999.99. |
| 9. 6.723 " 2.7981. | 13. 2 " 1.3678. |
| 10. 9.305 " 7.9. | 14. 17.36 " 9.0184. |

Find the value of:

15. $(7.2 - 2.75) - (1.9 - .0027)$.
16. $36 + 7.07 - 24.896 - (3.164 - .799)$.
17. $(273.29 - 41.802) - (7.162 + 51.386 - .09863)$.

EXERCISE 79

1. A sovereign weighs 123.274 gr., and a shilling 87.271 gr. Find their difference in weight.
2. Take eleven thousandths from eleven hundredths.
3. Add together the sum and difference of seventy-three thousandths and one hundred and fifteen millionths.
4. From a piece of muslin containing 27.5 yd., a merchant sold 13.75 yd. How much was left?
5. From one thousand take one millionth.
6. To how many pounds of chicory must 28.786 lb. of coffee be added to produce 34.35 lb. of mixture?
7. A Manitoba farmer had two sections of land, and sold 450.625 a. How many acres had he left?
8. A owns nine-tenths of a ship. He sells eight hundred and eighty-eight thousandths of it. How much has he left?
9. When a certain number is taken away from 25.375, 2.7869 is left. Find the number taken away.
10. From a roll of wire 37.125 yd. long, 8.75 yd. are cut. How much remains?
11. How much must be added to 247.368 to make up 300?

EXERCISE 80

Simplify:

1. $94.7 - 48.08 + 41.76 - 36.875 - 27.846$.
2. $78 - 16.45 - 24.786 - 9.95 + 18 - 16.7$.
3. $53 + 52.6 - 18.8946 - 31.254 - .5 + 32.18$.
4. $1.6 + 7.84 + 6.875 - 3.999 - 5.5555$.
5. $.008 + 10.4 - 3.576 - 2.8497 + 7.567$.
6. $6 - 2.45 - 3.745 + 8.674 + 3.245 - 7$.
7. From the sum of 101.01 and 1.001 take their difference.
8. Find the least number which, added to the sum of .12, 1.5, .07, and 80.3, will make the result a whole number.
9. Mr. Jones, who owned 160.5 a. of land, sold 13.125 a. to one man and 16.004 a. to another. How many acres had he left?
10. From 561.09 take the sum of the sum and difference of 2.845 and 3.7.
11. Add together 1.648, .0432, and .0007, and subtract the result from 4.
12. A is to travel 600 mi. in three days. The first day he travels 196.5 mi. and the second day 203.75 mi. How far must he travel the third day?

IV. MULTIPLICATION OF DECIMALS

EXERCISE 81

INTRODUCTORY

1. Multiply each of the following numbers by 3:—
5, 7, 9, 12, 13.
2. Multiply each of the following numbers by 3:—
.5, .7, .9, 1.2, 1.3.

3. Multiply each of the following numbers by 3:—
.05, .07, .09, .12, .13.

4. Multiply each of the following numbers by .3:—
5, 7, 9, 12, 13.

5. Multiply each of the following numbers by .03:—
.5, .7, .9, 1.2, 1.3.

6. Multiply each of the following numbers by .003:—
.05, .07, .09, .12, .13.

7. State a rule for determining how many decimal places there are in the product of examples 4, 5, and 6.

8. Multiply the following by 10:—.7, .8, .07, .08, .007, .008.

9. What is the effect of multiplying a number by 10 on the position of the decimal point?

10. Multiply the following by 100:—.7, .8, .07, .08, .007, 8.

11. What is the effect on the position of the decimal point of multiplying by 100?

12. By merely moving the decimal point, multiply each of the following numbers by 100:—7.25, 80.1, .064, 7.006, 5.025.

13. Give a rule for multiplying any number by 10; by 100; by 1000.

EXERCISE 82

1. How many decimal places will there be in the product of 84.78 and 3.75? In the product of 7.846 and .0078?

	(2)	(3)	(4)	(5)
Multiply	4.64	53.062	.1346	675.1
By	3.35	4.53	.203	.008
	<hr/>	<hr/>	<hr/>	<hr/>

Multiply

- | | |
|---------------------|---------------------|
| 6. 713 by 3.47. | 11. 714.6 by 1.124. |
| 7. 3.96 by .068. | 12. 9.006 by .0045. |
| 8. 9.07 by 1.06. | 13. 1.001 by 1.009. |
| 9. .008 by .009. | 14. .005 by 3.009. |
| 10. 13.14 by .0236. | |

EXERCISE 83

1. A knot equals 1.1515 mi. Find the length of 49 knots.
2. When a certain number is divided by 3.25, the quotient is 2.00968. Find the number.
3. How many square yards are there in a rectangular lot 56.25 yd. deep and 13.75 yd. wide?
4. Obtain the continued product of 10.45, 1.045, and .1045.
5. Find the cost of 8384 ft. of boards at \$16.75 per thousand.
6. Find the continued product of .014, 350, 380.15, .00832, and 500000.
7. A square link contains 62.726 sq. in. What is the area in square inches of 5327 sq. links?
8. A pint of water weighs 1.25 lb. Avoirdupois. What is the weight of 7.8 pints?
9. Gold is 19.26 times as heavy as water. What weight of gold is of the same bulk as 17.342 lb. of water?
10. The circumference of a circle measures 3.14159 times its diameter. What will be the length of the circumference of a circle whose diameter measures 37.258 mi.?
11. Find the product of the sum and difference of .27 and 27.
12. What is the weight of 5 cu. ft. of water if a cubic foot weighs 62.455 lb. Avoirdupois?

V. DIVISION OF DECIMALS

EXERCISE 84

INTRODUCTORY

1. Compare .0005, .005, .05, .5, and 5.
2. What is the effect on a number of moving the decimal point one place to the right? Two places? Three places?
3. $\frac{1}{3} \div 5$; $\frac{10}{30} \div 5$; $\frac{100}{300} \div 5$; $\frac{1000}{3000} \div 5$.
4. What is the effect on the quotient when the divisor and dividend are both multiplied by the same number?
5. Divide each of the following numbers by .05:—
35; 3.5; .35; .035; 5.5; .55.
6. Divide each of the following numbers by $.002\frac{1}{2}$:—
7, .07, .007, 7.2, .72, .072.
7. Divide each of the following numbers by 5:—
4, 1.4, .24, 3.21, .04, .004.

EXERCISE 85

Divide:

- | | | |
|-------------------|------------------|--------------------|
| 1. 16.578 by 5.4. | 5. 3.1 by .0025. | 9. 202 by .01. |
| 2. 48.591 by .96. | 6. .0012 by 1.6. | 10. 406.8 by .018. |
| 3. 2.56 by .0032. | 7. .0774 by 480. | 11. 1.066 by 13. |
| 4. 4.126 by 640. | 8. 21.3 by 37.5. | 12. 15.77 by 19. |

EXERCISE 86

1. What number must be multiplied by .0064 to give 10?
2. How often can 1.314 be taken from 394.2?
3. Divide .1 by .001, and the quotient by 2.
4. The area of a rectangular field is 3414.012 sq. yd. Its width is 125.7 yd. What is its length?

5. If 36.35 yd. of cloth cost \$117.95, find the cost of 1 yd.

6. A certain number is added to .3005 and the sum divided by 2.04. The result is 2.6375. Find the number added to .3005.

7. How many bushels will fill a bin 6 ft. 5 in. long, 4 ft. 3 in. wide, and 5 ft. 7 in. deep, there being 2218.192 cu. in. in a bushel?

8. If 38.4 bu. of wheat are worth 86.4 bu. of oats, how many bushels of wheat are worth 199.8 bu. of oats?

9. A farmer sold .125 of his crop of hay in January, .585 in February, and the remainder, 24679 lb., he kept for his own use. Of how many tons did his crop consist?

10. If 20.5 a. of land produce 345.876 bu. of wheat, how much will 30.75 a. yield at the same rate?

11. A miller invested \$232 $\frac{1}{2}$ in an equal number of bushels of oats, wheat, and corn; \$.40 per bushel for the oats, \$.875 for the wheat, and \$.45 for the corn. How many bushels of each did he buy?

12. A rod of iron measures 3.298 ft., and it expands .000012 of its length for every degree of temperature it is raised. How much will it measure when its temperature is raised 25 degrees?

EXERCISE 87

1. Multiply 350.4 by .0105 and divide the product by .0000219.

2. At \$1.75 per rod, what will it cost to fence a rectangular piece of land 63.5 rods long and 27.75 rods wide?

3. Divide the product of .037 and .0025 by the sum of .9, .02, and .005.
4. A cubical cistern is 5 ft. deep. How many gallons of water will it hold if 277.274 cu. in. make a gallon?
5. The weight of a cubic foot of water is $62\frac{1}{2}$ lb., and an imperial gallon contains 277.274 cu. in. Find the weight in ounces of a pint of water.
6. What is the least number that must be taken from the sum of $69\frac{1}{2}$, 8.2, 5.445, .065, and $20\frac{1}{12}$, so that it will contain 0.05 an exact number of times?
7. The length of a second's pendulum is 39.37079 in. If 64 French metres are equal to 70 yd., by what decimal of an inch will the length of a second's pendulum differ from one metre?
8. A drover lost .065 of his flock by wolves, .105 by disease, and .27 by theft. He then sold .75 of what remained, and had 280 sheep left. Find the number of his original flock.
9. Find the value of $\frac{.321 \times .321 - .179 \times .179}{.321 - .179}$ of \$20.
10. From the sum of 6, .4; .08 and .005 take 5.481. Multiply the remainder by .0069 and divide the result by .23.
11. If £100 are worth \$486.67, find the value of an English shilling.
12. The great pyramid of Cheops measures 763.4 ft. on each side of its base, which is square. How many acres does the pyramid cover?
13. If iron weighs 7.112 times as much as water, and water weighs 1000 oz. per cubic foot, how many cubic inches of iron will weigh half a ton?

VI. REDUCTION OF DECIMALS

EXERCISE 88

Express the following decimals as common fractions in their lowest terms:

- | | | |
|----------|-------------|--------------|
| 1. .7. | 6. .0614. | 11. .00036. |
| 2. .36. | 7. .0078. | 12. .02007. |
| 3. .08. | 8. .7614. | 13. .712465. |
| 4. .784. | 9. .3005. | 14. .000006. |
| 5. .709. | 10. .00427. | 15. .000875. |

Express the following fractions as decimals:

- | | | |
|------------------------|---------------------------|------------------------------|
| 16. $\frac{1}{10}$. | 20. $\frac{136}{1000}$. | 24. $126\frac{367}{1000}$. |
| 17. $\frac{17}{100}$. | 21. $2\frac{7}{100}$. | 25. $\frac{18498}{100000}$. |
| 18. $\frac{37}{100}$. | 22. $4\frac{1}{100}$. | 26. $3\frac{7}{100000}$. |
| 19. $\frac{7}{100}$. | 23. $16\frac{38}{1000}$. | 27. $16\frac{163}{100000}$. |

EXERCISE 89

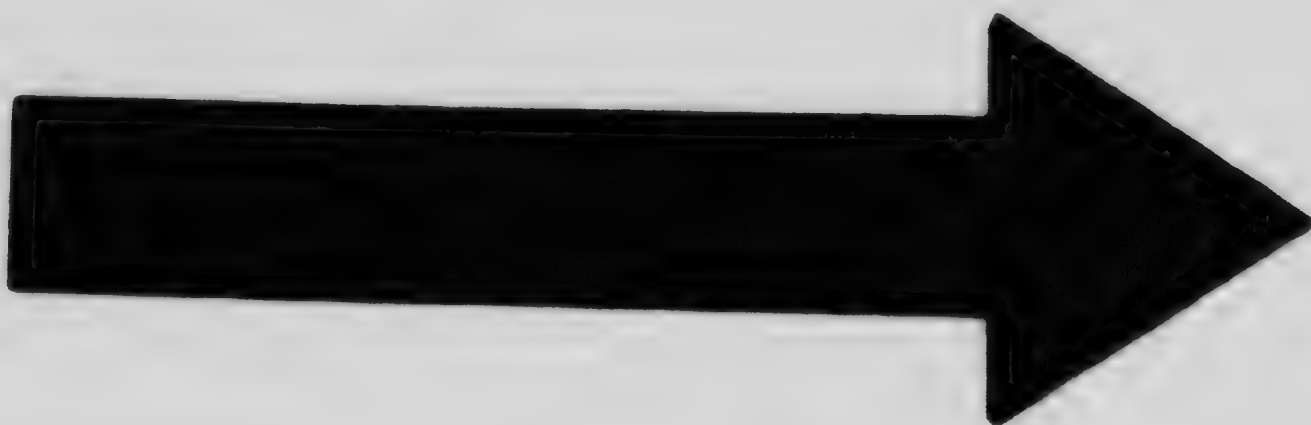
(INTRODUCTORY)

1. Divide 687 by 5, explaining each step in the process.
2. Divide 4 by 5, explaining each step in the process.
3. Divide 7 by 8, explaining each step in the process.
4. Reduce $\frac{1}{8}$ to a decimal.
5. Reduce $\frac{3}{8}$ to a decimal.
6. Reduce $\frac{5}{8}$ to a decimal.
7. Reduce $\frac{3}{16}$ to a decimal.
8. Reduce $\frac{7}{8}$ to a decimal.
9. Reduce $\frac{1}{16}$ to a decimal.
10. Give a rule for reducing a vulgar fraction to a decimal.

EXERCISE 90

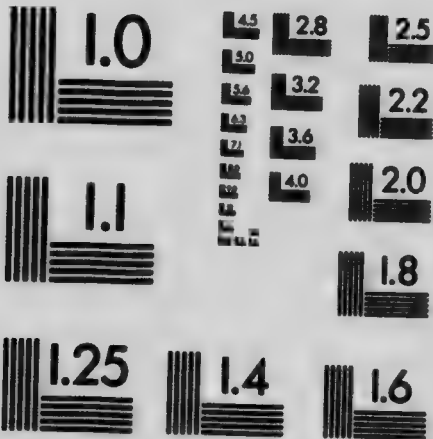
Reduce the following to decimals:

- | | | |
|---------------------|-----------------------|------------------------|
| 1. $\frac{3}{4}$. | 6. $\frac{5}{80}$. | 11. $6\frac{3}{8}$. |
| 2. $\frac{5}{8}$. | 7. $1\frac{7}{8}$. | 12. $24\frac{1}{15}$. |
| 3. $\frac{1}{16}$. | 8. $\frac{11}{100}$. | 13. $3\frac{3}{8}$. |
| 4. $\frac{9}{40}$. | 9. $\frac{5}{64}$. | 14. $46\frac{5}{16}$. |
| 5. $\frac{5}{32}$. | 10. $1\frac{1}{15}$. | 15. $47\frac{9}{16}$. |



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EXERCISE 91

1. Change to common fractions in their simplest form:—.25, .36, .96, .096, .375.
2. Change to decimal form: $\frac{2}{5}$, $\frac{1}{1000}$, $1\frac{7}{8}$, $1000\frac{364}{1000}$.
3. Express in decimal form: $5\frac{7}{10}$, $34\frac{8}{100}$, $6\frac{3}{4}$, $8\frac{1}{10}$.
4. Express as common fractions in their lowest terms:—.6 $\frac{1}{4}$, .4 $\frac{3}{4}$, .04 $\frac{3}{4}$, .087 $\frac{1}{2}$.
5. Change to mixed numbers in their simplest form:
7.5 $\frac{1}{2}$, 4.3 $\frac{2}{10}$, 5.16 $\frac{3}{4}$, 7.0 $\frac{1}{2}$.
6. Reduce each of these fractions to hundredths:
 $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{3}{8}$, $\frac{1}{12}$, $\frac{5}{12}$.
7. Change the following to decimals, and find the sum of the decimals:— $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{10}$, $2\frac{1}{4}$, $1\frac{1}{10}$, $\frac{3}{10}$.
8. Cut as many tablecloths as possible, each containing 3 $\frac{1}{2}$ yd., from 23.35 yd. of damask, and find how much material remains.
9. Multiply .1234 by 10; by 100; by 1000; by 10000.
10. Divide .1234 by 10; by 100; by 1000; by 10000.
11. What number divided by 1.25 will give the continued product of 11, 1.1, .001 $\frac{1}{10}$?
12. What number, multiplied by .4 of 7.8, gives .25 of .4 of 8 $\frac{3}{4}$ as product?

VII. CIRCULATING DECIMALS

8. If we reduce $\frac{5}{8}$ to a decimal we get .625; if, however, we reduce $\frac{2}{3}$ to a decimal we get .66666 with a remainder of 2 and we find that the operation can never be completed because there is a remainder. Such a decimal is called a repeating, recurring or circulating decimal.

Reduce the following to decimals:

$$\frac{1}{3}, \frac{2}{3}, \frac{7}{9}, \frac{6}{7}, \frac{5}{12}, \frac{8}{8}.$$

$$\frac{1}{3} = .333333, \text{ etc. which is written } \dot{.3}$$

$$\frac{2}{3} = .666666, \text{ etc. " " " } \dot{.6}$$

$$\frac{7}{9} = .777777, \text{ etc. " " " } \dot{.7}$$

$$\frac{6}{7} = .857142857142, \text{ etc. " " } \dot{.857142}$$

$$\frac{5}{12} = .4166666, \text{ etc. " " " } \dot{.416}$$

$$\frac{8}{8} = .833333, \text{ etc. " " " } \dot{.83}$$

Thus from the above we find that $\frac{1}{3}, \frac{2}{3}, \frac{7}{9}, \frac{6}{7}$ result in decimals in which all the digits repeat, but that $\frac{5}{12}$ and $\frac{8}{8}$ result in decimals in which one or more figures do not repeat. To distinguish one from the other we call decimals such as $\dot{.6}$ and $\dot{.857142}$ pure repeating decimals and $\dot{.416}$ and $\dot{.83}$ as mixed repeating decimals.

EXERCISE 92

Express as decimals the following:—

- | | | |
|----------------------|----------------------|-----------------------|
| 1. $\frac{5}{8}$. | 5. $\frac{19}{27}$. | 9. $\frac{12}{11}$. |
| 2. $\frac{3}{8}$. | 6. $\frac{17}{14}$. | 10. $\frac{22}{13}$. |
| 3. $\frac{4}{8}$. | 7. $\frac{13}{13}$. | 11. $\frac{19}{10}$. |
| 4. $\frac{11}{12}$. | 8. $\frac{27}{25}$. | 12. $\frac{14}{15}$. |

REDUCTION OF CIRCULATING DECIMALS

Reduce $\dot{.4}$ to a fraction:

$$10 \text{ times } \dot{.4} = 4.444444, \text{ etc.}$$

$$1 \text{ " } \dot{.4} = .444444, \text{ etc.}$$

$$9 \text{ " } \dot{.4} = 4$$

Therefore

$$\dot{.4} = \frac{4}{9}$$

Similarly

$$\dot{.2} = \frac{2}{9}; \dot{.5} = \frac{5}{9}, \text{ etc.}$$

Reduce $\dot{.24}$ to a fraction:

100 times $\dot{.24} = 24.24242424$, etc.

1 " $\dot{.24} = .24242424$, etc.

99 " $\dot{.24} = 24$

Therefore $\dot{.24} = \frac{24}{99}$

9. A pure circulating decimal may be expressed as a fraction by setting down for numerator the figures that compose the decimal, and for denominator as many nines as there are figures in the decimal.

Similarly $\dot{.43} = .4\dot{3} = \frac{4\dot{3}}{10} = \frac{39}{90}$

and $\dot{.435} = .4\dot{3}\dot{5} = \frac{4\dot{3}\dot{5}}{10} = \frac{431}{990}$ or

100 times $\dot{.43} = 43.333333$, etc.

10 " $\dot{.43} = 4.333333$, etc.

90 " $\dot{.43} = 39$

Therefore $\dot{.43} = \frac{39}{90} = \frac{43 - 4}{90}$ and

1000 times $\dot{.435} = 435.35353535$, etc.

10 " $\dot{.435} = 4.35353535$, etc.

990 " $\dot{.435} = 431$

Therefore $\dot{.435} = \frac{431}{990} = \frac{435 - 4}{990}$

10. From the above it will be seen that if we subtract the part that does not repeat from the whole decimal, we get a number corresponding to the numerator of the fraction. Hence to reduce a mixed circulating decimal to a common fraction, subtract the part that does not repeat from the whole decimal; take this as numerator and for denominator as many nines as there are figures in the repeating part, followed by as many zeros as there are figures in the non-repeating part.

Express as fractions in their lowest terms :

- | | | | | |
|----|--------|---------|--------|----------|
| 1. | .6; | .72; | .437; | .142857. |
| 2. | .3427; | .2856; | .09; | .383. |
| 3. | 4.234; | 2.0026; | .3568. | 5.345 |

11. When an accurate result is not required, circulating decimals may be added or subtracted by extending each decimal and performing the operation. Thus, to add $.38$, $26\bar{3}$, and $.4589\bar{6}$ correct to four decimal places, extend the decimals to six places, being two more than the required number.

.383838
.263333
.458964

$$1.106135 = 1.1061$$

If an accurate result is required, however, the decimals may be reduced to vulgar fractions and then added, which would make a tedious operation; or we may proceed as follows:

Add

$.4\dot{3}$; $\overbrace{.56\dot{3} \text{ and } .27\dot{3}\bar{8}}$

$.4\dot{3} = .433333333333333333333333333333\dots$

$.56\dot{3} = .563636363636363636363636363636\dots$

$.27\dot{3}\bar{8} = .273873873873873873873873873873\dots$

The sum is $1.\overbrace{2708435708435708}^{\text{repeating}}\dots = 1.\dot{2}\dot{7}0843\dot{5}$

Subtraction may be carried on in the same manner.

Add correct to four places:

- $$\begin{array}{r} 1. \quad .8, \quad .382, \quad .4336. \\ 2. \quad .36, \quad .364, \quad .27, \quad .00018. \end{array}$$

- .. $.4\dot{5}67$, $.4285\dot{7}$, $.2\dot{8}3\dot{2}$.
 4. From $.32\dot{6}$ take $.01\dot{8}\dot{6}$.

Find the exact sum of the following:

5. $.4$, $.38\dot{2}$, $.003\dot{5}$.
 6. $.5\dot{3}$, $.23\dot{6}$, $.256\dot{9}$.
 7. $.0000\dot{5}\dot{2}$, $.453\dot{7}$, $.9$, $.3\dot{4}$.
 8. $.29\dot{1}$, $.63\dot{2}$, $.256\dot{3}$.
 9. From $13.68\dot{2}$ take $9.00\dot{7}$.

10. From $5.14285\dot{7}$ take $4.28571\dot{4}$ and express the result as a fraction in its lowest terms.

VIII. DECIMALS OF DENOMINATE NUMBERS

EXERCISE 95

INTRODUCTORY

1. Express $\frac{1}{2}$ pound in ounces; express .5 of a pound in ounces.
2. Express .125 of a ton in pounds.
3. Find the number of inches in .75 of a yard.

Example 1. What is the value of .7875 of £1?

$\text{£}7875$	$.7875 \text{ of } \text{£}1 = .7875 \text{ of } 20\text{s.}$
$\underline{20}$	$= 15.75\text{s.}$
$\text{s. } 15.7500$	$.75 \text{ of } 1\text{s.} = .75 \text{ of } 12\text{d.}$
$\underline{12}$	$= 9\text{d.}$
$\text{d. } 9.0000$	Hence, $.7875 \text{ of } \text{£}1 = 15\text{s. } 9\text{d.}$

4. Find the value of .25 of an hour.
5. How many inches are there in .5 yd.?
6. A room is .8 rd. wide. How many feet wide is it?
7. A parcel weighs .75 lbs. How many ounces does it weigh?

8. A lesson on Arithmetic lasted .65 hr. How many minutes did it last?

9. The distance between two posts is 5.4 yd. How many feet are these posts apart?

10. A book weighed 2.25 lbs. How many ounces did it weigh?

EXERCISE 96

Find the value of:

- | | |
|---------------------------|-------------------------|
| 1. .94375 of 1 acre. | 7. .965625 of 1 mile. |
| 2. .815625 of 1 lb. Troy. | 8. .778125 of 1 ton. |
| 3. .875 of 1s. | 9. .628125 of £1. |
| 4. .785 of 1 hour. | 10. 3.4583 of 1s. |
| 5. .497 of 1 day. | 11. 2.5384375 of 1 day. |
| 6. .4375 of £1. | 12. .002083 of £1. |

EXERCISE 97

INTRODUCTORY

- Express 4 ft. as the fraction of 5 ft.
- Express 4 ft. as the decimal of 5 ft.
- Express 9 in. as the fraction of 1 yd.
- Express 9 in. as the decimal of 1 yd.
- Express 2 ft. 3 in. as the fraction of 1 yd. and then express 2 ft. 3 in. as the decimal of 1 yd.
- Express 6d. as the decimal of 1s.
- Express 3 hr. as the decimal of a day.
- Express 16 lb. as the decimal of a ton.
- Express 36 lb. of wheat as the decimal of a bushel.

Example 2. Reduce 17s. 5½d. to the decimal of £1; and express £3 17s. 5½d. in £'s only.

4 | 1 far.	1 far. = ¼d. = .25d.
12 | 5.25d.	5½d. = 5.25d.
20 | 17.4375s.	5.25d. = $\frac{5.25}{12}$ s. = .4375s.
£.871875	∴ 17.4375s. = $\frac{17.4375}{20}$ £ = .871875 £.
	Hence, £3 17s. 5½d. = £3.871875.

EXERCISE 98

1. Reduce 10s. 6d. to the decimal of £1.
2. Reduce 5 cwt. 64 lb. to the decimal of 1 ton.
3. Reduce 15 dwt. 15 gr. to the decimal of 1 oz. Troy.
4. Reduce 248 rd. to the decimal of 1 mile.
5. Reduce 2 qt. 1 pt. to the decimal of 1 peck.
6. Express £9 5s. 4½d. in pounds only.
7. Express 17 cwt. 89 lb. 8 oz. in cwt. only.
8. Express 7 bu. 3 pk. 1 gal. in bushels only.
9. Express 3½ ft. as the decimal of 1 fathom.
10. What decimal of 4 oz. is 2 oz. 16 dwt. 19.2 gr.?
11. Express 5 da. 9 hr. 46 min. 48 sec. in hours only.
12. Express $\frac{7}{8}$ of $\frac{1}{2}$ of 22½ lb. as the decimal of 1 ton.

EXERCISE 99

1. Express 6.3 min. as the decimal of a week.
2. At a certain place the daily rainfall for a week was:—0.4, .00, 1.02, .84, .00, .14, 1.54 in. Find the average daily rainfall.
3. Find the value of:
 $.375$ of 10s. + $.015625$ of 4s. — $.125$ s. + $.625$ of 2s. 6d.
4. The average of four quantities is 18.65; the first is 26.207, the second 3.592, and the third is 38.06. Find the fourth.
5. Express the sum of .4 mi. .424 rd. .4246 yd. as the decimal of a mile.
6. Express 5 wk. 5 da. 9 hr. 46 min. 48 sec. as weeks.
7. Which is the greater, .27 of 3 mi. or .72 of a mile, and by how many yards?
8. Cork, whose weight is .24 of that of water, weighs 15 lb. per cubic foot. Find the weight of 3 cu. ft. of oak, which weighs .934 times as much as water.

9. Six bells which commence tolling together, toll at intervals of 1, 1.2, 1.5, 1.75, 1.8, 2.1 sec., respectively. At what intervals will they toll together?

10. If 28 men do $\frac{1}{4}$ of .315 of a piece of work in 3.663 days, how many men will do the whole work in 16.28 days?

EXERCISE 100

1. .4 of A 's money is invested in mines; .025 in ships, and the remainder, amounting to \$2532.30, is on deposit in the bank. How much is A worth?

2. By what must 1.00503 be divided, so that $\frac{1}{4}$ of the quotient may be .859?

3. If 65.25 gal. of brandy are worth £73 13s. 8d., what are 9.6 gal. worth?

4. Divide 20 oz. of gold among A , B , and C , so that A 's share may be equal to .4 of B 's, and B 's 1.3 of C 's.

5. A cubic metre contains 1.308 cu. yd. and a gallon 277.274 cu. in. How many gallons will contain a cubic metre?

6. Add together $\frac{3}{11}$ of an acre, $\frac{4}{11}$ of 40 sq. rd., and 7.5625 sq. yd., giving the result in square feet.

7. In a town of 240756 inhabitants, it was found that .0475 of the whole could not read, and only .575 of those able to read could write. How many were there of each?

8. A and B step together; A takes 2.5 ft. each step, and B 2.785 ft. When B has gone a mile, what part of a mile has A still to go?

9. From Hamburg to Bremen is 22.75 German miles, or 109.5 English miles. What fraction of a German mile is an English mile?

10. A cubic foot of water weighs 10 $\frac{1}{2}$ oz. Find the weight of water in a rectangular cistern 6.2 ft. long, 4.5 ft. wide, and 3.75 deep.

11. Divide \$576.58 among 3 men and 4 women, giving each man 1.75 of a woman's share.

EXERCISE 101

1. The unit is £21 12s. 9d. What is the decimal measure of £8 9s. 3d.?

2. What number multiplied by .4 will give 15.6 mi. as product?

3. Express the sum of 7.125 mi. 3.375 rd. .8625 yd. as feet.

4. Simplify .625 a. + .28125 a. + 4.75 sq. rd. - .3025 sq. rd.

5. If .25 of a house is worth \$2557.50, find the value of .125 of it.

6. What number divided by 7.72 will produce 33 mi. 186 rd. 1 yd. 2 ft. 6 in.?

7. Add together .5125 yd., .62734 rd., and .018325 of 40 rd. Subtract the result from .06 mi., and express the answer in yards.

8. Simplify:

$$\frac{4 \text{ da. } 18 \text{ hr.}}{10 \text{ da. } 15 \text{ hr.}} + \frac{£4}{£9 \text{ 6s. } 8 \text{ d.}} - \frac{3 \text{ rd. } 2 \text{ yd. } 8 \text{ in.}}{15 \text{ rd. } 1 \text{ yd. } 2 \text{ ft. } 3 \text{ in.}}$$

9. If the pressure of the atmosphere is 14.75 lb., find the pressure on a rectangular surface 7.74 in. long by 5.3 in. wide.

10. If .275 of the price of a yard of cloth exceeds $\frac{1}{4}$ of the price by $9\frac{1}{4}$ ¢, what is the price per yard?

IX. GENERAL REVIEW

EXERCISE 102

1. Write 30303.0303 in words.

2. Write in figures seven thousand, and seven thousandths.

3. Find the cost of 8750 ft. of lumber at \$26 per M.
4. If 100 gal. of milk weigh as much as 103 gal. of water, find the weight in grains of a pint of milk.
5. A sidereal day is 23 hr. 56 min., and the mean solar day is 24 hr. Reduce the difference between the two to the decimal of a sidereal day.
6. If a 5-cent piece weighs 16 grains, find the value of the 5-cent pieces that will weigh 12 lb. avoirdupois.
7. A mixture of green and black teas is made, 3 oz. of green to every 5 oz. of black. How much of each kind will there be in 2 lb. of the mixture?
8. A woman sold 8 turkeys and 8 geese for \$11.60, getting 25c. a piece more for each turkey than for a goose. What price did she get for each?
9. John, James, and Henry had \$1800 divided amongst them. James got twice as much as John, and Henry got twice as much as both John and James. How much did each get?
10. Find the cost of carpeting a room 20 ft. 6 in. long, and 17 ft. 8 in. wide, with carpet 27 in. wide, and costing \$1.25 per yard, if the strips run lengthwise, and 6 in. of each strip be turned under for matching.
11. Divide \$520 among A, B, and C, so that when A receives \$1.25, B may receive 80c. and C 55c.
12. The weekly wages of 3 men and 4 boys is \$45. If a man earns twice as much as a boy, what does each man and each boy earn in 1 day?
13. Divide \$82.60 among 27 men and 37 boys, so that each man may have three times as much as each boy.

14. Gunpowder is composed of nitre, charcoal and sulphur, in the proportion of 15, 3, and 2. A certain quantity of gunpowder is known to contain 20 cwt. of charcoal. Find its weight, and also the weight of nitre and sulphur it contains.

15. A farmer agreed to pay his hired man 10 sheep and \$160 for one year's labor. The man quit work at the end of 7 months, receiving the sheep and \$60 as a fair settlement. Find the value of each sheep.

16. A gravel-bank has a surface area of 1 a. and is 5 ft. deep. What length of road 14 ft. wide will it gravel to the depth of 9 in.?

17. \$1200 is to be divided between two persons, *A* and *B*, so that *A*'s share is to *B*'s share as 2 to 7. Find the share of each.

18. Divide \$57.89 between two men, so that one may receive one-third as much again as the other.

19. If \$19.20 is divided among 6 men, 12 women, and 15 boys, so that 2 men may receive as much as 5 boys, and 2 women as much as 3 boys, how much will each man receive?

20. The mean height of 5 trees is 91 ft. What must be the height of a sixth tree which brings the average up to 94 ft.?

21. *A*'s wages for 6 days average \$1.20 a day. On Monday he earns \$1.80 and on Wednesday \$2.40. What is his average rate of wages for each of the four remaining days?

22. Find the aggregate and also the average price of 12 geese at \$1.66 per pair, 15 turkeys at \$1.05 each, 17 chickens at 17c. each, and 12 ducks at 60c. per pair.

23. A farmer had 3 fields of wheat. The first had $17\frac{1}{2}$ a. and averaged 20 bu. to the acre; the second had 15 a. and averaged $22\frac{1}{2}$ bu. to the acre; the third had $12\frac{1}{2}$ a. and averaged 26 bu. Find the average yield per acre and the value of the crop at 65c. per bushel.

24. A merchant bought 3 pieces of cloth of 72 yd. each; 5 pieces of 72 yd. each; 7 pieces of 96 yd. each, and 9 pieces of 48 yd. each. Find the aggregate number of yards and the average length of the pieces.

25. By mixing 3 lb. of his best coffee with 7 lb. at 20c. a pound, a merchant produced a mixture worth 23c. a pound. What was the price of the best coffee?

26. A cheese factory during one season made 25 cheese, each weighing 35 lb., at 8c.; 30 cheese of 40 lb. each, at $8\frac{1}{2}$ c.; 30 cheese of 36 lb. each, at 9c.; and 40 cheese of 38 lb. each, at $9\frac{1}{4}$ c. Find the average weight of a cheese and the average price per pound.

27. A drover bought 60 cows at \$22 a head; 80 at \$25 a head; and 60 at \$28 a head. Find the aggregate cost and average price per head.

28. Find the average of the following quantities:

$10\frac{1}{10}$, $4\frac{1}{10}$, $15\frac{1}{2}$, 6, $66\frac{1}{2}$, $7\frac{1}{2}$.

29. A cricketer averaged 32.5 runs in twelve matches. How many runs did he make in the thirteenth to reduce his average to 32?

30. Copper weighs 550 lb. and tin 462 lb. to the cubic foot. What will be the weight of a cubic foot of a mixture of 6 parts copper and 5 parts tin?

31. How much water must be added to 92 gal. of brandy, worth \$4.60 per gallon, in order that the mixture may be worth only \$3.60 per gallon?

32. A piece of land is surrounded by a stone wall 8 ft. high and 2 ft. thick; the land inside the stone wall

is 100 ft. long and 50 ft. wide. How many cubic feet of stone does the wall contain?

33. How many miles must be travelled by a team in ploughing lengthwise a piece of land 60 rd. long and 40 rd. wide, if each furrow is 10 in. wide?

34. A lot 11 rd. long and 9 rd. wide has a fence built round it. Outside the lot, at a distance of 2 ft. from the fence, a sidewalk 4 ft. wide is built. How many square yards of ground does the sidewalk cover?

35. How many thousand shingles 18 in. long and 4 in. wide, lying $\frac{1}{4}$ to the weather, are required to shingle the roof of a building 54 ft. long, with rafters 22 ft. long, the first row of shingles being double?

36. Find the expense of sodding a plot of ground which is 40 yd. long and 100 ft. wide, with sods each a yard in length and a foot in breadth, the sods when laid costing 75c. per hundred.

37. It is required to build a sidewalk a quarter of a mile in length, 8 ft. wide, and 2 in. thick, supported by three continuous lines of scantling 4 in. square. What will the lumber cost at \$17 per thousand feet?

38. In a room 26 ft. 6 in. long, 16 ft. 8 in. wide, and 12 ft. 3 in. high, there are three windows, each $5\frac{1}{2}$ ft. high and 3 ft. wide, and two doors, each 7 ft. high and $3\frac{1}{2}$ ft. wide. The baseboard is 9 in. wide. How much paper $\frac{7}{8}$ of a yard wide will be required to cover the walls and ceiling if there is no waste of paper?

39. A school room is 30 ft. long, 24 ft. wide, and 10 ft. high above the wainscoting. The trustees pay \$20 per thousand for a new floor, \$15 per thousand for a new board ceiling, 10c. per square yard for painting the ceiling, 4c. per square yard for tinting the walls and \$2 per day for 6 days' labor. Find the total cost.

CHAPTER V

PERCENTAGE

EXERCISE 103

INTRODUCTORY

1. A boy spends 1 out of every 4 cents he has. How much does he spend out of 12 cents? Out of 20 cents?
2. A boy spends 2 out of every 10 cents he has. How many does he spend out of 40 cents? Out of 100 cents?
3. A drover had 400 sheep. He sold 9 out of every hundred or 9 per cent. How many did he sell?
4. A man paid away 8 dollars out of every hundred dollars he had. How much did he pay out of \$200? Out of \$300?
5. How much is 7 out of every 100, or 7 per cent. of 400? (In business a short way of writing per cent. is %.)
6. How much is 5 per cent. of \$100? 7%? 20%?
7. How is 5 per cent. of a quantity found? 7%? 20%?
8. What does the term per cent. mean?
9. Express 7% as a number of hundredths; 9%; 15%; 25%.
10. Express as common fractions: 5%, 10%, $12\frac{1}{2}\%$; 20%, 25%, $33\frac{1}{3}\%$.
11. 10% of a string is 3 in. long. How long is the entire string?
12. A string is 100 ft. long. What per cent. of its length is 7 ft.? 12 ft.? 25 ft.? 30 ft.?
13. What per cent. of a quantity is $\frac{1}{10}$ of it? $\frac{1}{20}$ of it?

14. Express the following as hundredths and as per cent.:

$\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, $\frac{3}{8}$, $\frac{5}{16}$, $\frac{7}{32}$, $\frac{9}{64}$.

15. What per cent. is 1 ft. of 2 ft.? 1 in. of 4 in.? \$1 of \$5? 6 hr. of 1 da.?

16. What per cent. is any number of itself?

EXERCISE 104

Express the following as hundredths:

- | | | |
|-----------------------|------------------------|------------------------|
| 1. $7\frac{1}{2}\%$. | 3. $33\frac{1}{3}\%$. | 5. $37\frac{1}{2}\%$. |
| 2. $6\frac{1}{4}\%$. | 4. $12\frac{1}{2}\%$. | 6. $87\frac{1}{2}\%$. |

Express the following decimals in percentages:

- | | | |
|-----------|------------|-----------|
| 7. .055. | 9. .25. | 11. .033. |
| 8. .0725. | 10. .2525. | 12. 125. |

Express the following as common fractions in their lowest terms:

- | | | |
|-------------------------|-------------------------|-------------------------|
| 13. $12\frac{1}{2}\%$. | 15. $16\frac{2}{3}\%$. | 17. $38\frac{1}{2}\%$. |
| 14. $11\frac{1}{4}\%$. | 16. $33\frac{1}{3}\%$. | 18. $87\frac{1}{2}\%$. |

Express the following common fractions as percentages:

- | | | |
|----------------------|----------------------|----------------------|
| 19. $\frac{1}{4}$. | 21. $\frac{1}{8}$. | 23. $\frac{3}{8}$. |
| 20. $\frac{1}{16}$. | 22. $\frac{1}{32}$. | 24. $\frac{1}{64}$. |

EXERCISE 105

- | | |
|--|------------------------------------|
| 1. Find $\frac{1}{100}$ of 1600; of 1800; of 2500. | |
| 2. Find .08 of 1100; of 1300; of 1500. | |
| 3. Find 8% of 1600; of 1800; of 2000. | |
| 4. 16% of 450. | 10. $5\frac{1}{2}\%$ of \$200. |
| 5. 20 " of \$75. | 11. $2\frac{1}{2}$ " of 600 men. |
| 6. $33\frac{1}{3}$ " of 69 sheep. | 12. $7\frac{1}{2}$ " of 630. |
| 7. $12\frac{1}{2}$ " of 360 ft. | 13. $6\frac{1}{2}$ " of 96 men. |
| 8. $11\frac{1}{2}$ " of \$225. | 14. $8\frac{1}{2}$ " of 576 sheep. |
| 9. $37\frac{1}{2}$ " of 40 mi. | 15. $87\frac{1}{2}$ " of \$320. |

EXERCISE 106

1. A sold 30 yd. of cloth from a web containing 120 yd. What per cent. of the web did he sell?

From 120 yd. he sold 30 yd.;

\therefore part sold = $\frac{30}{120}$ of web = $\frac{1}{4}$ of web = $\frac{25}{100}$ of web = 25%.

2. A man had 50 sheep and sold 3 of them. What per cent. of his sheep did he sell?

3. A man had 25 ducks and lost 7 of them. What part of his ducks did he lose? What per cent. of them?

4. A man had \$200, and gained \$13 more. What part of his original money was his gain? What per cent. of it?

5. What per cent. of a quantity is the $\frac{1}{2}$ of it? $\frac{1}{4}$ of it? $\frac{3}{4}$ of it? $\frac{1}{3}$ of it? $\frac{2}{3}$ of it?

6. A merchant sold 80 yd. of cloth from a web containing 250 yd. What per cent. of the web did he sell?

7. A farmer who had 800 bu. of wheat sold 320 bu. What per cent. of his wheat did he sell?

8. A fourth of a field has been ploughed. What per cent. of the field remains to be ploughed?

9. 780 is what per cent. of 1300? of 2145?

10. In a class of 48 pupils, 4 are absent. What per cent. are absent?

11. A man's income is \$1760; his expenses are \$1056. What per cent. of his income does he save?

12. $2\frac{1}{2}$ is what per cent. of $3\frac{1}{2}$?

13. The population of a city has increased in ten yr. from 52550 to 62900. Find the increase per cent.

EXERCISE 107

1. Find the number of which 275 is 25%.
2. How much must be a clerk's salary in order that 17% of it may be \$204?
3. A farmer buys a field which adds 19% to his original farm of 300 a. Of how many acres did the farm then consist?

4. A man sold a field consisting of 25 a., which was 12% of his farm. How many acres were in the farm before he sold the field?

5. A farmer made a profit of 25% by selling sheep at \$5 per head. What did he pay for the sheep?

6. A drover sold horses at \$90 a head and lost 10%. What did he pay per head for the horses?

7. A man spends 70% of his income and saves \$615. Find his income.

8. A sample of an alloy was found to contain 15 lb. of copper, which was 75% of the total weight. Find the weight of the sample.

9. A merchant gained \$5460 in business. This was 75% of what he gained the previous year. How much did he gain that year?

10. What number increased by 40% of itself equals 847?

11. A sold a house for \$5400. He gained $12\frac{1}{2}\%$ on the cost of the house. Find the cost of the house?

12. A library consists of English and classical books. The number of English books is 2196; this is $76\frac{1}{4}\%$ of the whole number of books in the library. How many books does the library contain?

EXERCISE 108

1. In a factory there are 264 men, women, and boys. Find the number of each, if there are $33\frac{1}{3}\%$ more women than boys and 25% more men than women.

2. The sum of two numbers is 7785, and one is $16\frac{1}{4}\%$ more than the other. Find the numbers.

3. A town whose population was 10000, increased 10% every year for 3 yr. What was its population at the end of that period?

4. A man having lost 20% of his capital, is worth exactly as much as another who has just gained 15% on his capital; the second man's capital was originally \$9000. What was the first man's capital?

5. Brown purchased $\frac{7}{8}$ of a mill property for \$4064.55, and Smith purchased $\frac{9}{8}$ of the same property at a rate 5% higher. What did Smith's part cost him, and what fraction of the property remains unsold?

6. A man dying, left $33\frac{1}{3}\%$ of his property to his wife; 50% of the remainder to his son; 75% of the residue to his daughter; and the balance, \$540, to a children's hospital. How much did the daughter receive?

7. A farmer raised 20% more wheat this year than last. During both years he raised 1320 bu. How many bushels did he raise each year?

8. *A* and *B* each sold 240 a. of land, *A* gaining $7\frac{1}{2}\%$ and *B* losing $12\frac{1}{2}\%$. If *A* received \$960 more than *B*, what did each pay an acre for the land?

9. *A*'s capital was increased by 10% for two successive years and then it amounted to \$5687. What was his original capital?

10. *A*'s share of a sum of money is $\frac{1}{2}$ of it. This is 8% more than *B*'s and 8% less than *C*'s. What are *B*'s and *C*'s shares of it?

11. A man owning $\frac{3}{4}$ of a foundry sold $\frac{1}{4}$ of his share to *A*, and $\frac{1}{4}$ of the foundry to *B*. What per cent. of the foundry did he still own?

12. By selling goods for \$380, *A* gains three times the per cent. that he would gain by selling them for \$340. What per cent. is gained in the latter case?

13. *A* is 36 yr. old; *B* is $33\frac{1}{3}\%$ older than this. In how many years will *B* be 20% older than *A*, could both live as long?

EXERCISE 109

1. If a house costs \$1200, and is sold to gain 40%, how much is gained and what is the selling price?

2. A merchant invests \$6575 in goods, and sells them to gain 18%. What is his gain?

3. Bought 500 tons of coal at \$4.20 a ton, and sold it at 27% advance. What was the total gain and the gain per ton?

4. A merchant purchases sugar at \$7.50 per cwt. At what price per pound must he sell it in order to gain 10%?

5. A merchant bought 1000 yd. of carpet at 60c. per yard, and sold $\frac{1}{2}$ of it at a profit of 30%, $\frac{1}{4}$ at a profit of 20%, and the rest at a loss of 20%. How much did he receive for the carpet?

6. A bought a house for \$3500, expended \$550 in repairing it, and then sold it at a loss of 8% on the total cost. For how much did he sell the house?

7. A grain dealer bought wheat for \$9384, and sold it at a gain of $4\frac{1}{2}\%$. How much did he receive for it?

8. 840 bu. of wheat, bought at 74c. per bushel, were sold at a profit of $12\frac{1}{2}\%$. For how much was the wheat sold?

9. A bought a lot for \$275; he sold it to B at an advance of 40%; B sold it to C at an advance of $9\frac{1}{11}\%$. How much did C pay for the lot?

10. A paid \$270 for a lot; he sold it to B at an advance of $33\frac{1}{3}\%$; B sold it to C at a loss of $33\frac{1}{3}\%$. How much did C pay for the lot?

11. A tradesman bought certain articles at \$1.75 per score. What number should he sell for \$1.26 to gain 20%?

12. Find the selling price of goods on which there is a loss of 3% and an actual loss of \$117.80.

13. Fill in the blanks in the following:

	Cost of Article	Selling Price	Gain in Dollars	Gain %
(a)	\$24	\$36	....	.....
(b)	\$84	....	\$21	.....
(c)	...	\$75	\$15	.....
(d)	\$120	....	....	$33\frac{1}{3}\%$
(e)	....	\$1740	\$290	.....
(f)	....	\$2480	....	$33\frac{1}{3}\%$
(g)	....	\$1984	....	$6\frac{1}{2}\%$

14. Fill in the blanks in the following:

	Cost of Article	Selling Price	Loss in Dollars	Loss %
(a)	\$56	\$48	....	.....
(b)	\$32	\$24	....	.....
(c)	\$96	....	....	$16\frac{2}{3}\%$
(d)	....	\$120	....	25%
(e)	....	\$165	\$35	.....

CHAPTER VI

APPLICATIONS OF PERCENTAGE

I. TRADE DISCOUNT

12. Wholesale merchants and manufacturers catalogue their goods at certain fixed prices. Usually these are the prices charged by the retailers. The price in the catalogue is called the *list, gross, invoice, or catalogue price*.

13. To enable the retail merchant to make a profit, a deduction is made from the list price. If the price which the retail merchant paid were printed in the catalogue, and it fell into the hands of one buying from him, he would, naturally, think that the retailer was overcharging him. Then, also, with a catalogue containing the retailers' prices, the wholesale merchant or manufacturer can meet the fluctuations of the market by merely increasing or decreasing the rate of allowance off the retail prices.

14. Sometimes a second deduction is allowed off what remains after deducting the first one. This is to induce prompt payment by the retail merchant. At times a third deduction is allowed off certain kinds of goods, but this is a matter of special arrangement between the buyer and seller.

EXERCISE 110

INTRODUCTORY

1. A manufacturer allows a deduction of 25% from a bill of \$300. How much will the purchaser pay?
2. How much will pay for a bill of goods for \$600, the allowance off being at the rate of $33\frac{1}{3}\%$?

3. A creditor allows 10% off a debt of \$120. How much will settle the debt?

15. The sum deducted from a bill or debt, is called *Discount*.

4. The catalogue price is \$500. The price paid is \$375. What is the discount?

16. The allowance made by merchants and manufacturers upon their catalogue prices, is *Commercial or Trade Discount*.

5. Find the discount on a debt of \$25 at 10%.

6. Find the trade discount on an invoice of \$450 at $33\frac{1}{2}\%$.

7. How much will pay for goods invoiced at \$60, the rate of discount being 25%?

8. A bill of goods amounts to \$80. Two discounts are allowed, one at 25% and one at 5%. How much will settle the bill?

17. The amount of a bill less the discounts, is called the *Net Amount, or Net Price*.

Example 1. Find the net price of goods invoiced at \$375, there being two successive discounts of 20% and 5%.

The invoice price is.....	\$375
The first discount is 20% of \$375.....	= 75
The first reduced price is.....	\$300
The second discount is 5% of \$300.....	= 15
The net price is.....	\$285

EXERCISE 111

Find the net price of the following bills:

1. Invoice price \$540, discount 25%.

2. Invoice price \$248, discount $37\frac{1}{2}\%$.

Find the net price of goods bought as follows:

3. Invoice price \$820, discounts off 25% and 5%.

4. Invoice price \$1630, discounts off 20%, 10%, and 5%.

5. An invoice was \$500, trade discounts 20% and 5% off. Find the cost of the goods.

6. What is the net amount of a bill of goods, the list price of which is \$345, trade discounts 8% and 5% off for cash?

7. What is the difference on an invoice of \$340, between 40% direct discount, and discounts 25% and 15%?

8. A bill of groceries at list prices amounts to \$276.45; the discounts are 40%, 12½% and 5%. What is due on the bill?

9. Find the rate of discount when \$157.50 is allowed off a bill for \$420.

10. A bill of goods, list price \$441.60, was settled for \$276. What rate of discount was allowed?

11. At what price must goods which cost \$216 be listed to give 25% gain, after allowing 25%, 20%, and 10% off.

Example 2. What single discount is equal to discounts of 20% and 5%?

The first discount is 20% of the list price.

The first reduced price = $\frac{80}{100}$ of the list price.

The second discount is 5% of the first reduced price.

The second reduced price = $\frac{95}{100}$ of the first reduced price;

= $\frac{95}{100}$ of $\frac{80}{100}$ of list price,

= $\frac{76}{100}$ of list price.

Hence the single discount = 24%.

EXERCISE 112

1. Find a single discount equivalent to discounts of 25% and 5%.

2. Find a single discount equivalent to 25%, 10% and 5%.

3. What direct discount is equivalent to 20% and 10%?

4. A dealer buys a book, list price \$1, at a discount of 20%; he sells the book for \$1. What per cent. is the profit?

5. What is the net amount of a bill of \$360, discounts being $12\frac{1}{2}\%$ and 8%? Find a single discount equivalent to these successive discounts.

6. A man paid \$190 for goods, at discounts of 20% and 5%. Find the list price of the goods.

7. A dealer paid \$288 for goods at 20% and 10% off. Find the list price of the goods.

8. One dealer in slates allows discounts of 25% and 10%; another allows discounts of 20%, 10%, and 5%. Which gives the better discount?

9. Successive discounts of $33\frac{1}{3}\%$, 20%, and 5% are equal to what single discount?

10. A bill of goods after successive discounts of $33\frac{1}{3}\%$, 10%, and 5% was settled for \$487.35. Find the list price of the goods.

II. PROFIT AND LOSS

EXERCISE 113

1. If an article costs \$20 and is sold for \$24, what is the profit?

2. If an article costs \$20 and is sold for \$16, what is the loss?

3. When is an article sold at a profit?

4. When is an article sold at a loss?

5. How is the amount of profit found?

6. How is the amount of loss found?

18. The *gain or loss* in business transactions is denoted by the Commercial term, *Profit and Loss*.

7. I bought an article for \$100, and sold it to gain 10%. Find the selling price.

8. An article cost 20c. and was sold for 30c. Find the gain per cent.

9. An article which cost 10c. was sold at an advance of 2c. Find the gain per cent.

10. An article which cost \$100 was sold for \$85. What was the loss per cent.?

EXERCISE 114

1. If I buy a pair of boots for \$6 and afterwards sell them for \$7.50, what per cent. do I gain?

2. A grocer sells a barrel of oranges for \$7.50 which cost him \$6.25. What is his gain per cent.?

3. A bought books for \$275 and sold them for \$264. Find his loss per cent.

4. A grocer bought eggs at 9d. per dozen and sold them $1\frac{1}{2}$ doz. for 1s. Find his loss or gain per cent.

5. A grocer retails his coffee so that he charges as much for 4 lb. as he paid for $6\frac{1}{2}$ lb. Find his gain per cent.

6. Brooms are bought wholesale at \$20 per gross. What per cent. profit will be made by selling them at 20c. each?

7. If books are bought at 11 for 10s. and sold at 10 for 11s., find the gain per cent.

8. A merchant buys hats at \$8 per dozen and retails them at \$1.50 each. Find his gain per cent.

9. A speculator sold half a section of land for the cost of $\frac{1}{3}$ of a section. Find his gain per cent.

10. A bought a carriage for \$84, which was 40% less than its value. He sold it for 5% less than its value. Find his gain per cent.

EXERCISE 115

1. A man sells a piece of cloth for \$52.67, and thereby gains 15%. What was the cost of the cloth?

2. Sold salt at \$1.37 per bushel, which was 5% less than cost. What was the cost?

3. The cost of coal is \$2.60, and the freight \$1.30 per ton. At what must I sell it to gain 30%?

4. A tradesman adds 35% to the cost price of his goods, and gives his customers a reduction of 10% on their bills. What profit does he make?

A merchant sold a piece of cloth for \$24, and thereby lost 25%. What per cent. would have been the gain had he sold it for \$34?

6. A sells goods to B at a gain of 12% and B sells the same goods to C at a gain of $7\frac{1}{2}\%$; C paid \$3762.50 for the goods. How much did A pay for them?

7. A dealer sold an article for \$8.10 and lost 10%. At what selling price would he have gained 10%?

8. A sold a town lot to B and gained $12\frac{1}{2}\%$. B sold it to C for \$306 and lost 15%. How much did the lot cost A?

9. A grocer bought 6 cwt. of sugar for \$52.10; he used 65 lb. himself and sold the rest so as to make $1\frac{1}{2}\%$ per pound profit on the whole quantity. How much per pound did he sell it for?

10. A farmer sells a merchant 30 bu. of wheat at 90c. per bushel, and makes a profit of 20%; the merchant sells the farmer 5 yd. broadcloth at \$3.60 per yard, 16 yd. calico at 8c. per yard, and 44 yd. cotton cloth at 13c. per yard, and makes a profit of 25%. Which gains the more by the transaction, and how much?

11. A man sold two farms for \$3000 each; on one he gained 20%, and on the other he lost 20%. Did he gain or lose on the whole, and how much?

III. COMMISSION

19. A business man often employs another to buy or sell goods, collect accounts, and transact business for him. The person so employed is known as an agent and is variously spoken of as a Commission Merchant, Broker, Factor, Collector, or Consignee, depending upon the kind of business he carries on for his employer, who is known as the Principal. Thus, a lumber merchant in Canada may have an agent in Liverpool,

England, to whom he consigns lumber to be sold; or a merchant in Canada may employ an agent in Paris, France, to buy and ship him certain kinds of goods.

20. The agent is paid a certain percentage of the sum received for the sales or expended . purchases.

21. The entire sum received for the goods sold is the *gross proceeds*. After the agent has deducted pay for his services, the necessary expenses, etc., what remains is called the *net proceeds*.

EXERCISE 116

INTRODUCTORY

1. How much will an agent receive for selling goods to the value of \$500 at 4%?

2. How much will the owner of goods which were sold for \$250 receive from his agent whose charge is 5%?

3. An agent who charged 5% of the sum received for the goods for selling them for another was paid \$60. For how much were the goods sold?

4. For buying a house an agent received \$340. He charged 4% of the sum for which the house was sold. Find how much the man who sold the house received for it and how much the house cost the purchaser.

The charge made by an agent for buying or selling goods, is called *Commission*.

EXERCISE 117

Find the commission on:

1. \$360 at 4%. 3. \$800 at $1\frac{1}{4}\%$. 5. \$7600 at $3\frac{1}{4}\%$.
2. \$790 at 2%. 4. \$1200 at $2\frac{1}{2}\%$. 6. \$4800 at $2\frac{1}{2}\%$.
7. At 3%, what is an agent's commission on a purchase of \$1250?

8. A broker buys 3 tons of currants at \$8.75 per cwt. What is his commission at $2\frac{1}{2}\%$?

9. An agent collected 80% of a debt of \$3250. What is his commission at $4\frac{1}{2}\%$, and how much did he pay over to his employer?

10. An agent collected 75% of a debt of \$1500, for which he received a commission at $3\frac{1}{2}\%$. How much did his principal receive?

11. A flour merchant sold 860 bbl. of flour at \$6.75 a barrel. Find his commission at $2\frac{1}{2}\%$. What were the net proceeds of the sale?

12. An agent sold a consignment of merchandise for \$5000. What was the balance due the consignor after deduction of \$115.75 freight, \$250 duty, cartage and storage, and 5% brokerage?

EXERCISE 118

1. If \$62.50 is charged for collecting \$1250, what is the rate of commission?

2. If a commission of \$106.47 is paid for selling \$3276 worth of goods, what is the rate of commission?

3. An agent who charges commission only on what he invests, received \$3672, and invests \$3600. What per cent. does he charge?

4. An agent received \$82.80 for buying goods to the value of \$1440. What was his rate of commission?

5. An agent having sold a consignment of flour for \$3578, retained \$95.70 to pay charges amounting to \$6.25 and his own commission. At what rate was his commission charged?

6. A broker invested \$3225.75 out of \$3300 for his principal. What rate of commission did he charge?

7. An agent purchased 5 t. of sugar at $5\frac{1}{2}$ c. per pound. His principal sent \$563.75 to pay for the sugar and the agent's charges. At what rate were his charges made?

8. A shipped 140 bbl. of apples to his agent, who sold them for \$410.55 and remitted such a sum as enabled A to realize \$2.55 per barrel. What rate of commission was charged?

9. A fruit broker sold \$680 worth of apples and, after deducting 5% commission and 20% for freight and other charges, invested the balance in oranges. If he invested \$500 in oranges, what rate of commission did he charge for the investment?

10. My agent bought \$325 worth of goods for me. After paying commission and \$8.25 freight, the goods cost me \$347.87½. What was the rate of commission?

EXERCISE 119

1. An agent receives \$27.45 for purchasing goods at 4½% commission. Find the value of the goods.

2. Find the amount of the sales when a commission of 2½% gives the agent \$36.81.

3. A lad earned \$25.76 collecting accounts for a physician. He was allowed 5½%. What amount did he collect?

4. I send my agent \$1470 with instructions to deduct his commission at 5% and invest the balance in wheat. How much does he invest?

The commission for buying \$100 worth of wheat is \$5. To purchase \$100 worth of wheat, then, the agent must receive \$105.

The agent therefore expends $\frac{105}{100}$ of the amount sent him;

$$= \frac{105}{100} \text{ of } \$1470$$

$$= \$1400;$$

∴ the amount invested in wheat is \$1400.

5. An agent charges 1¾% of the amount invested; he receives \$956.45 to invest and pay the commission. How much is his commission?

6. An agent receives \$31.55 as his compensation for purchasing goods at 4% commission. What amount must the principal remit to him to pay for the goods and the commission?

7. Sent \$2600 to my agent to invest after deducting his commission at 4%. What sum did he invest?

8. An agent bought 4000 bu. of wheat. His commission at $2\frac{1}{2}\%$ was \$62, storage and freight charges were \$58. How much per bushel did the wheat cost the principal?

9. How many barrels of flour at \$5 per barrel can be bought for \$3468, after deducting a commission of 2% for buying?

10. I sent my agent \$9180 with instructions to deduct his commission at 2% and invest the balance in wheat. How much wheat did he purchase at $67\frac{1}{2}$ c. per bushel?

11. An agent sold goods which cost \$1250 for \$1750. What per cent. profit did the principal make, if the agent charged $\$87\frac{1}{2}$ commission, \$25 freight, and $\$12\frac{1}{2}$ cartage?

IV. INSURANCE

22. Companies are organized to make good, losses of property from fire, water, wind, hail, lightning, or other specified causes. Such companies are called *Insurance Companies*. These are of two chief classes, *Stock Companies* and *Mutual Companies*. In the former, the capital is owned by the members of the company, who are called *Stockholders*. These share the profits, if any, and become responsible for the losses, in proportion to the capital which each man owns. In a *Mutual Insurance Company*, the persons whose properties are insured become members of the company and give *Premium Notes* for their proportionate shares of the salaries of the officials and possible losses. After these expenses are met, if there is any surplus, it is returned to the members of the company, *pro rata*.

23. The following are the chief kinds of property insurance:

- (1) *Fire Insurance*, or indemnity for loss by fire.
- (2) *Marine Insurance*, indemnity for loss or damage of vessels or their cargoes by the accidents of navigation.

- (3) *Insurance of Live Stock*, or indemnity for loss of horses, cattle, &c., by lightning, or other specified causes.
- (4) *Transit Insurance*, or indemnity for loss or damage to merchandise during transportation from one place to another.
- (5) *Accident Insurance*, or indemnity for loss of property by accident.
- (6) *Hail Insurance*, or indemnity for loss of standing crops by hail.

24. A person who wishes to effect an insurance makes an application to a company, usually through an agent of the company, who supplies him with the necessary form to be filled in and signed. If the agent approves of the application, he gives the applicant an *interim receipt* for the money paid and forwards the application to the company. The interim receipt binds the company until the policy is issued by the company or the application has been declined by it. In the latter case, the part of the sum paid proportionate to the unexpired time is returned.

25. If loss or damage occurs to the property, the person whose property is insured fills a *claim paper*, stating his loss. This is forwarded to the company which immediately sends an inspector to the place, who reports to the company the extent of the loss.

26. If the property is completely destroyed, the sum for which it was insured is paid. If the loss is only partial, the full value of the property destroyed is paid, provided this sum does not exceed the sum mentioned in the written agreement. No insurance company will insure property to the full extent of its value.

27. The written agreement of insurance is called *the Policy*.

EXERCISE 120

INTRODUCTORY

1. What sum must be paid for insuring a house for \$2000 at $1\frac{1}{4}\%$?

2. What must be paid to insure a vessel for \$5000 at 2% ?

3. What sum must be paid for insuring a building worth \$9000 for $\frac{3}{4}$ of its value at $\frac{1}{4}\%$?

4. The sum paid for insuring goods at $1\frac{1}{2}\%$ was \$60. For what sum were the goods insured?

28. The sum paid for the insurance is called the *Premium*. It is always a certain per cent. of the sum for which the property is insured.

EXERCISE 121

Find the premium on:

1. \$600 at 3% . 4. \$375 at 3% . 7. \$9500 at $1\frac{1}{4}\%$.

2. \$840 at $1\frac{1}{2}\%$. 5. \$8000 at $1\frac{1}{4}\%$. 8. \$4890 at $1\frac{1}{2}\%$.

3. \$760 at 2% . 6. \$7360 at $1\frac{1}{2}\%$. 9. \$6280 at $\frac{3}{4}\%$.

10. How much will it cost to insure a house for \$3000 at $\frac{5}{8}\%$, and the furniture for \$1600 at $\frac{3}{4}\%$?

11. A merchant had 1200 bbl. of flour, worth \$5.80 per barrel, insured for $\frac{3}{4}$ of its value at $1\frac{1}{2}\%$. Find the premium.

12. A factory is worth \$6500 and the machinery \$7500. The factory is insured for 80% of its value at $1\frac{1}{2}\%$, and the machinery for 75% of its value at $1\frac{1}{2}\%$. Find the premium paid.

13. A building was insured in 19 companies at \$1500 each, in 9 others for \$2500 each, and in 4 others for \$3500 each. What was the total annual premium at $\frac{3}{4}\%$?

EXERCISE 122

1. A farmer paid \$61.25 for insuring his property for \$3500. What was the rate charged?

2. If I paid \$34.35 for insuring property for \$4580, what was the rate charged?

3. A schoolhouse is insured for \$7800, and the premium is \$46.80. Find the rate of insurance.

4. A fire insurance company charged \$98.44 for insuring a house for \$8750. What rate per cent. was charged?

5. A merchant paid \$60 for insuring his stock of goods worth \$6000 for $\frac{1}{4}$ of their value. What was the rate of insurance?

6. A store worth \$4320 was insured for $\frac{1}{4}$ of its value. The premium was \$108. What rate of insurance was charged?

7. A shipment of goods was insured for \$6000. This sum covered the value of the goods, \$5930, the premium, and \$2.50 for expenses. What was the rate per cent. of the premium?

8. The sum of \$1802.50 was paid for the insurance, at $\frac{1}{4}$ of its value, of a ship worth \$360000. What was the rate per cent. of premium, if \$2.50 was charged for necessary expenses?

9. A vessel and cargo valued at \$35000 are insured for $\frac{1}{4}$ of their value at $1\frac{1}{4}\%$. If this vessel were destroyed, what will be the actual loss to the insurance company?

10. If a person who is insured for \$6000 at an annual premium of \$31.40 per \$1000, dies after 12 payments, how much more will his heirs get than has been paid in premiums?

EXERCISE 123

1. The premium at $2\frac{1}{4}\%$ on a cargo of goods amounted to \$1750. What was the value of the cargo?

2. Mr. Jones paid \$575 for the insurance of a cargo of wheat at $1\frac{1}{4}\%$. For what sum was it insured?

3. A man insured $\frac{1}{4}$ of the value of his stock of goods at $1\frac{1}{4}\%$ and paid \$77.92 premium. Find the value of the goods.

4. A man paid \$81 for insuring property for $\frac{1}{4}$ of its value at $1\frac{1}{4}\%$. Find the value of the property.

- (a) What is the premium on \$5000 at 2% ?
 (b) If a policy for \$5000 covers both the value of the property and the premium paid at 2%, what must be the value of the property?
 (c) For what sum should goods worth \$4900 be insured at 2% so that, in case of total loss, the owner may recover both the value of the goods and the premium paid?

The premium is 2% of amount of insurance, i.e., on \$100 of insurance the premium is \$2; \therefore \$100 insurance includes \$2 premium and \$98 worth of goods.

Since \$98 worth of goods bears \$100 insurance

$$\begin{array}{rclcl}
 \$1 & " & " & " & \$100 & " \\
 \$4900 & " & " & " & 4900 \times \frac{100}{98} & \\
 & & & & -\$5000 \text{ insurance.} &
 \end{array}$$

5. For what sum must a house worth \$2400 be insured at 4%, so that, in case it is burned, the owner may recover both its value and the premium paid?

6. I insured a factory at $\frac{2}{10}\%$ for one year, so as to recover both its value and the premium in case of total loss. The premium being \$270, what was the value of the factory?

7. A company agreed to insure property for enough more than its value to cover the premium also, at the rate of $\frac{3}{4}\%$. Find the amount of the policy if the property is worth \$9131.

8. A factory which had been insured for \$35000 for 10 yr., at $1\frac{3}{4}\%$, was totally destroyed by fire. How much did the sum received from the insurance company exceed the premiums paid?

V. TAXES

29. Money is needed to enable the Dominion, Provincial, and Municipal Governments to discharge their several duties. The money raised by these parties is called a *tax*. In the case of the Dominion and Provincial Governments, the money is expended in public

works, building and maintaining public institutions, paying officials, etc. Municipalities expend money in erecting and maintaining municipal buildings, making roads, building bridges, maintaining schools, paying the various municipal officials, etc.

30. When the tax is paid directly by the person who is to bear the burden, it is a *Direct Tax*.

31. When the tax is paid by a person who expects to have it repaid to him by increasing the price of an article on which a tax has been paid and which he sells to another, the tax is an *Indirect Tax*, and is called a *Duty*.

32. For direct taxation, property is regarded as *Real* or *Personal*. *Real Property* consists of *fixed* property, as land and houses. *Personal Property* consists of *movable* property, as cash, merchandise, cattle, salary, etc.

33. The township, town, or city councils appoint officers called Assessors or Assessment Commissioners, who estimate the value of all the taxable property in the municipality. Assessors report to the Council the name, address, and estimated value of all property, real and personal, of each resident of the municipality. This report is called the *Assessment Roll*.

34. When the Municipal Council has decided what the expenditure for the year will be, it proceeds to determine the *Rate of Taxation*. This is found by dividing the sum to be raised by the measure of the value of all the taxable property in the municipality. The sum to be paid by each tax-payer is then computed, and an official, called *the collector*, appointed by the Council, proceeds to receive the taxes.

35. Goods entering Canada from foreign countries are required to be landed at certain places, called *Ports of Entry*.

36. The Dominion Government has an establishment at each port of entry, called a *Custom House*, with one or more officers attached to it, called *Custom House Officers*. These inspect the goods, examine the invoices, collect the sums levied upon the goods, etc.

37. An *Invoice* is a statement of the kind and quality of the goods shipped to a purchaser, with their weight or amount, and the cost of each article, made out in the currency and weights and measures of the country from which the goods are imported.

38. The sums collected on imported goods are called *Customs Duties*.

39. Certain articles, such as spirituous or malt liquors, cigars, snuff, etc., manufactured in Canada, are required to pay an *Excise Duty*. At each place where these are manufactured there are one or more Government officials, called *Excise Officers*, whose duty it is to check the quantities manufactured, levy the duty, see that none is disposed of without paying duty, etc.

40. The duty on some articles is reckoned at a certain *Rate per Cent.* of their cost in the country from which they are imported.

This is called an *Ad Valorem Duty*.

41. On other articles the duty is levied on the quantity of the goods without regard to their cost.

This is called a *Specific Duty*.

42. On some articles both kinds of duties are levied.

EXERCISE 124

1. If a man pays annually 1% of the value of his property, estimated at \$10000, what is the amount of his tax?

2. If I am taxed $1\frac{1}{2}\%$ on real estate valued at \$8000, what is the amount of my tax?

3. The people of a school section wish to build a new schoolhouse, which will cost \$2850. The taxable property of the section is valued at \$190000. What will be the tax in the dollar, and what will be a man's tax whose property is valued at \$7590?

4. A town is to be taxed \$23200 on an assessed valuation of \$2900000. What is Jones's tax on an assessed valuation of \$5400?

5. Find the duty on 2750 gal. of spirits at \$1.92 per gallon.

6. Find the duty on 8 hhd. of sugar, each weighing 1200 lb. gross, at 1½c. per pound, 16% being allowed for tare.

7. Find the duty on an importation of ready-made clothing, invoiced for \$1750, at 35%.

8. Find the duty on an importation of 375 lb. of sugar-candy, invoiced at 4c. per pound, on which a specific duty of ½c. per pound and an ad valorem duty of 35% are levied.

9. A town needs \$24000 for a new schoolhouse, \$15000 to pay salaries of teachers and others, and \$5000 for expenses. It receives \$2000 in Government grants. The rest was raised on property valued at \$2800000. What is the tax rate?

10. A lives in a town in which the taxable property is valued at \$1600000. A tax of \$25000 is to be levied. Find A's tax, if he is assessed for \$7640 for real estate and \$2860 for personal property.

11. A school district is assessed for \$150000. The trustees have built a schoolhouse costing \$1800.

(a) What will the schoolhouse cost a ratepayer whose property is assessed for \$4500?

(b) What would be the *rate* of taxation per annum on the whole section if the house were paid for in six equal annual payments, without interest?

12. The expense of building a bridge was \$1768, which was defrayed by a tax upon the property of the town. The valuation on the property being \$544000, what was the rate of taxation in mills on the dollar?

EXERCISE 125

1. In a certain school district the rate of taxation is $5\frac{1}{2}$ cents per acre. Find the amount of taxes if there are 12280 acres of assessable land.

2. In a school district in which there are 15420 acres of assessable land the rate of taxation is 4.25 cents per acre. Find the amount of taxes collected if 5 quarter-sections are non-assessable.

3. A land company owns five quarter-sections in a certain school district in which the rate of taxation is 6.5 cents per acre. Find the amount of the taxes due.

4. In a certain school district 4 miles square the rate of taxation is \$6.40 per quarter-section. Find the amount of taxes to be raised.

5. The trustees of a certain school district 4 miles long and 3 miles wide estimate that in addition to the grant received from the Government for a certain year it will be necessary to raise \$432 by taxation. If three quarter-sections in the district are non-assessable what rate per acre will it be necessary to strike?

6. In 1907 the rate of taxation in a district containing 18 sections of assessable land was 4.5 cents per acre. For 1908, however, the trustees estimated that their expenses would be increased by \$288. What rate had to be struck for 1908?

7. A ratepayer in a district in which the rate of taxation is 5.25 cents per acre pays taxes to the amount of \$33.60. How many acres does he own?

8. For 1908 the trustees of a rural school district containing 21 sections, assessed at \$10 an acre, estimated that their expenses would be as follows:—Teacher's salary \$660, Secretary-Treasurer's salary \$25, payment on debenture loan \$180, incidentals \$145.60. The Government grant is estimated at \$364.40, rent of school for meetings \$24. If there was \$84.00 cash on hand at the beginning of the year, what rate must be struck in order to meet the estimated expenditure?

9. A man owns three city lots which are assessed at \$700, \$600, and \$400 respectively. If the rate of taxation is 15 mills on the dollar, find the total amount of his taxes.

10. A tax of \$3750 is levied on a village, the assessed valuation being \$250000. What tax does a man pay whose income is \$1500, \$700 being exempt?

11. A man receives a salary of \$2500. His net income is \$2471.20 after paying an income tax on all over \$700. Find the rate of taxation.

12. A man paid \$25.60 income tax. If \$800 of his income is exempt from taxation and the rate is 16 mills on the dollar, find his income.

13. In a city the total assessment amounts to \$250000. In the city a man whose property is assessed for \$15000 pays \$300 taxes. Find the total tax levied in the city and the rate in mills on the dollar.

EXERCISE 126

1. What is the assessed value of property taxed \$37.80 at the rate of $4\frac{1}{2}$ mills on the dollar?

2. If the tax in a town is \$5775, and the rate $17\frac{1}{2}$ mills on the dollar, what is the assessed valuation of the property?

3. At the rate of $15\frac{1}{2}$ mills on the dollar, what must be the assessed value of property to yield \$9150?

4. An incorporated village allows 5% for collecting its taxes. A sum of \$3610 is needed after paying the collector. This is raised by $12\frac{1}{2}$ mills on the dollar. Find the assessed value of the property.

5. B paid a tax of \$67.50 on property where the rate of taxation was $1\frac{3}{4}\%$. Find the assessed value of his property.

6. A paid a tax of \$109.08. The rate of taxation was $14\frac{1}{2}$ mills on the dollar. His real property was assessed for \$4325. Find the assessed value of his personal property.

7. An importer paid \$7320 duty on a consignment of manufactured furs. Find the invoiced valuation the duty being 30%.

8. How many pounds of rice are there in a consignment, valued at 4c. per pound, on which the duty \$48, made up of a specific duty of 2c. per pound and an ad valorem one of 10%?

9. A building costing \$18135 was built by the proceeds of a tax levied upon property in a town, the rate of taxation being 5 mills on the dollar, and the cost of collection $2\frac{1}{2}\%$. Find the assessed valuation of the property.

10. The rural municipality of Wolverine No. 34 in the Province of Saskatchewan, contains nine townships. Find the number of acres it contains. If the total assessment in this municipality amounts to \$3,110,400, find the amount of taxes that would be raised in 1914 if a rate of 6 mills on the dollar were imposed.

EXERCISE 127

1. Allowing 5% for taxes uncollectable, and $2\frac{1}{2}\%$ for collection, what sum must be levied that \$7410 may be realized for municipal purposes?

2. A person, after paying an income tax of 22 mills on the dollar, has \$2934 left. What is his income?

3. A jeweller imported 30 doz. watches from Geneva invoiced at 420 francs per dozen. Find the duty at 25%, allowing a franc to equal \$.193.

4. Find the duty on 20 hhd. of molasses, each containing 63 gal., invoiced at 24c. per gallon, at 50% ad valorem, allowing $1\frac{1}{2}\%$ for breakage.

5. An importation of aromatic spirits of ammonia invoiced at \$1.50 per gallon, on which a specific duty of \$2.40 per gallon and an ad valorem duty of 30% are charged, required \$798 to release it from bond. How many gallons were there?

6. The duty on musical instruments is 25%. For what sum must a merchant sell imported organs on which he paid \$367.50 duty, so as to gain 20%?

7. If goods invoiced at \$875 cost \$1265 when laid down in the warehouse, the insurance and carriage amounting to \$83.75, find the rate of duty.

8. After paying a tax of 16½ mills on the dollar on all his salary over \$700, A has \$2421.30 left. Find his salary.

9. In a town, the amount to be raised by local tax is \$44250. A, whose property is assessed for \$8400, pays \$157.50 tax. What is the assessed valuation of the property?

10. A merchant bought 250 pieces of silk, each piece containing 100 yd., at 5 francs per yard. He was charged 35% ad valorem duty and \$60 for shipping charges. He sold it at \$1.50 per yard. Find his gain, the franc being 19.3c.

11. A rural municipality in the Province of Saskatchewan consists of

Township 16	Range 22	Township 17	Range 24
" 16	" 23	" 18	" 22
" 16	" 24	" 18	" 23
" 17	" 22	" 18	" 24
" 17	" 23		

west of the second meridian.

(a) Draw a diagram to represent the municipality.

(b) Calculate the number of sections and the number of acres it contains.

(c) If the assessed value of this land averages \$16 an acre, find the total assessment.

12. (a) A rural municipality in the Province of Saskatchewan, consisting of nine townships, borrowed by debenture on Dec. 15, 1912, \$12,000 payable in 10 equal annual instalments with interest at 6% per annum, payable annually. Make a schedule indicating the dates the various payments fall due and the amount of each.

(b) If in 1914, in addition to the debenture payment it is estimated that the general expenses of the council will amount to \$5616.96, find the rate that must be struck in order to meet the requirements for that year if the total assessment amounted to \$2,488,320.

(c) Calculate a man's taxes on a section of land assessed at \$16 an acre for the year 1914, if in addition to the above the school tax of 4 mills on the dollar must be paid.

VI. INTEREST

EXERCISE 128

INTRODUCTORY

1. *A* hires a horse from *B* for a day. Why does *A* pay money to *B*?

What is the money *A* pays to *B* called?

2. *C* rents a farm from *F* and agrees to pay a certain sum each six months. Why does *C* pay money to *F*?

What is the money *C* pays to *F* called?

3. *D* engages *P* to work for him. Why does *D* pay money to *P*?

What is the money *D* pays to *P* called?

4. If *A* lends *B* \$500, and *B* has to pay *A* \$6 for each \$100 per year, how much will *A* receive in 1 yr.? For what is the money paid to *A*? At the end of the year to whom does the \$500 belong?

5. How much must you pay for the use of \$600 for 1 yr., if you have to pay 5¢ for the use of each \$100 per year, or 5c. for each dollar? If you have to pay \$6? \$4? \$8?

43. The sum paid for the *use* of money is called *Interest*.

44. The money on which the *interest* is paid is called *Principal*.

45. The number of dollars paid for the use of \$100 for 1 yr. is called the *Rate per cent*.

NOTE—When the *rate per cent.* is stated without the mention of any length of time, the time is understood to be 1 yr.

6. I ask a man to lend me some money. He said he would at 6%. What did he mean?

46. When one man borrows money from another, he usually gives him a paper, called a *promissory note*, to show that he has borrowed the money.

47.

PROMISSORY NOTE

\$100.

Toronto, July 2, 1914.

One year from date, I promise to pay to James Ross, or order, one hundred dollars, with interest at 6%.

Value received.

Abel Jones.

7. Examine this note.

Who borrowed money?

From whom was money borrowed?

How much must be paid by the borrower at the end of the year?

Why is the sum paid back more than the sum borrowed?

EXERCISE 129

Find the interest on the following sums:

- | | |
|--|--|
| 1. \$600 for 1 yr. at 5%. | 4. \$3152.16 for 1 yr. at $7\frac{1}{2}\%$. |
| 2. \$550 for 1 yr. at 7%. | 5. \$3684.15 for 1 yr. at $6\frac{1}{2}\%$. |
| 3. \$840 for 1 yr. at $6\frac{1}{4}\%$. | 6. \$4568.75 for 1 yr. at $7\frac{1}{8}\%$. |

7. A man borrowed \$7200 for 1 year, viz., \$1250 at 7%; \$1340 at $7\frac{1}{2}\%$; \$2360 at 8%; and the remainder at $8\frac{1}{2}\%$. How much interest has he to pay at the end of the year?

8. Four brothers have to divide equally the interest of \$25800 at 7%. How much does each receive each year?

9. What is the interest on \$986 for 4 yr. at 6%?

10. What is the interest on \$1573 for 4 yr. at 5%?

11. What is the interest on \$2245.85 for 5 yr. at $6\frac{1}{2}\%$?

12. What is the interest on \$294 for 3 yr. 7 mo. at 6%?
13. What is the interest on \$954 for 4 yr. 8 mo. at 7%?
14. What is the interest on \$504.72 for 3 yr. 10 mo. at 5%?
15. State how the interest on a sum of money is found.

EXERCISE 130

1. If *A* borrows \$500 for 6 mo. at 8% from *B*, what sum must *A* pay *B* to be out of his debt at the end of the 6 mo.?

48. The sum of the principal and interest is called the *Amount*.

Example 3. If a man borrows \$480 for 8 mo. at 8%, what amount should he return at the end of that period?

$$\begin{aligned}\text{Interest on \$480 for 8 mo.} &= \frac{8}{12} \text{ of } \frac{8}{100} \text{ of \$480} \\ &= \$ 25.60\end{aligned}$$

$$\text{Principal} = \$480.00$$

$$\text{Amount} = \$505.60$$

2. What is the amount of \$840 for 10 mo. at 6%?
3. What is the amount of \$1573 for 4 yr. at 5%?
4. To what sum will \$784 amount in 2 yr. 9 mo. at 7%?
5. Find the amount of \$756 for 7 mo. at $6\frac{1}{2}\%$.
6. Find the amount of \$942 for 3 mo. at $5\frac{1}{3}\%$.
7. What sum will discharge a debt of \$1896 for 9 mo. at $7\frac{1}{2}\%$?

Example 4. Find the interest on \$1200 from March 1, 1899, to May 31, 1902, at 7%.

$$\begin{aligned}\text{Time from March 1, 1899, to May 31, 1902} \\ &= 3 \text{ yr. 91 da.}\end{aligned}$$

$$\text{Interest on \$1200 for 3 yr. at 7\%} = \$252.00$$

$$\begin{aligned}\text{" " \$1200 for 91 da.} &= \frac{91}{365} \text{ of } \frac{7}{100} \text{ of \$1200} \\ &= \$20.94.\end{aligned}$$

$$\begin{aligned}\text{" " " for 3 yr. 91 da.} &= \$ (252 + 20.94) \\ &= \$272.94\ldots\end{aligned}$$

8. Find the interest on \$500 for 156 days at 7%.
9. Find the interest on \$7500 from May 5 to Oct. 27 at 6%.
10. Find the interest on \$408.80, at 7%, from July 3, 1911, to Feb. 3, 1912.

EXERCISE 131

At what rate per cent. must \$756 be put at interest for 4 yr. to yield \$241.92?

$$\text{Interest on \$756 for 1 year} = \$ \frac{241.92}{4} = \$60.48;$$

$$\text{" } \$1 \text{ " } = \$ \frac{60.48}{756}$$

$$\text{" } \$100 \text{ " } = \$ \frac{100 \times 60.48}{756}$$

$$= \$8;$$

\therefore the rate = 8%.

A man pays \$72 for the use of \$900 for 1 yr. What is the rate per cent.?

2. A man lent \$484 for 5 yr., and received \$181.50 for the interest. What was the rate per cent.?

3. If \$103.68 interest is received on a principal of \$432 for 4 yr., what is the rate per cent.?

4. At what rate per cent. will \$824 amount to \$957.90 in 3 yr. 3 mo.?

5. I borrow \$125, and at the end of 16 mo. return \$134. Find the rate of interest.

6. A residence costing \$7500 is rented for \$56.25 per month. What rate per cent. per annum does the money yield?

7. Seven months after date a note for \$1800 amounted to \$1873.50. What was the rate of interest?

8. The amount of \$1022 for 260 days is \$1054.76. At what rate per cent. per annum is the money loaned?

9. At what rate is £84 14s. the interest on £2400 for $1\frac{1}{4}$ yr.?

10. The interest on \$870 for 4 yr. 6 mo. is \$274.05. How much will \$1000 amount to in 3 mo. at the same rate?

11. At what rate per cent., simple interest, will \$1600 amount to 3 times itself in 25 yr.?

EXERCISE 132

Example 5. In what time will \$800 amount to \$880 at 8%?

$$\text{Interest} = \$880 - \$800 = \$80.$$

The interest of \$800 for 1 yr. at 8% is \$64.

Time to produce \$64 = 1 yr.;

$$\begin{aligned} \text{" " } & \$80 = \frac{\$80}{\$64} = 1\frac{1}{4} \text{ yr.} \\ & = 1 \text{ yr. 3 mo.} \end{aligned}$$

Find the time in which

1. The interest on \$360 at $6\frac{1}{4}\%$ will be \$67.50.
2. The interest on \$275 at 6% will be \$56.25.
3. The interest on \$560 at $7\frac{1}{2}\%$ will be \$94.50.
4. The amount of \$600 at $5\frac{1}{2}\%$ will be \$613.75.
5. The amount of \$876 at 6% will be \$909.84.
6. On what day will be the interest on \$803, loaned on June 10, at 6%, be \$23.10?
7. How long a time would be required for \$525 to gain \$110.25 at 7%?
8. A principal of \$600 was loaned May 20, 1896, at $7\frac{1}{2}\%$. At what date did it amount to \$796.87 $\frac{1}{2}$?
9. A note given for \$273.25 at 7% remained unpaid until the interest equalled the principal. How long did it run?
10. In what time will any sum of money double itself at 6% simple interest?

EXERCISE 133

Example 6. What principal will bring \$200 interest in 146 da. at 5%?

Principal to give \$5 in 365 da. = \$100;
 " " \$200 " 365 da. = $\frac{200}{5}$ of \$100;
 " " \$200 " 1 da. = $365 \times \frac{200}{5}$ of \$100;
 " " \$200 " 146 da. = $\frac{146}{5}$ of $\frac{200}{5}$ of \$100
 = \$10000.

1. What principal will produce \$39.90 interest in 1 yr. at $5\frac{1}{4}\%$?

2. What principal will produce \$63.45 interest in $1\frac{1}{4}$ yr. at 6% ?

3. A man borrowed money at 7% and paid \$245 interest a year. How much money did he borrow?

4. What sum of money will produce \$300 interest in $2\frac{1}{4}$ yr. at 6% simple interest?

5. Suppose a gentleman's interest on money, at 6% , is \$45 per month, how much is he worth?

6. A man bequeathed his wife \$875 a year, his daughter \$770 a year, and his son \$630 a year. What sum must be invested at 7% to produce these sums?

Example 7. What principal will amount to \$496 in 1 yr. 4 mo. at 5% ?

The interest on \$100 at 5% for $1\frac{1}{3}$ yr. = $\$6\frac{2}{3}$;
 \therefore the principal which amounts to $\$106\frac{2}{3}$ in $1\frac{1}{3}$ yr. = \$100;

\therefore " " " \$496 " $1\frac{1}{3}$ yr. = $\frac{496}{106\frac{2}{3}}$;
 of \$100 = \$465.

Find the principal that

7. Amounts to \$382.50 in 1 yr. at $6\frac{1}{4}\%$.

8. Amounts to \$694.30 in 1 yr. 6 mo. at 4% .

9. Amounts to \$772.50 in 8 mo. at $4\frac{1}{2}\%$.

10. Amounts to £560 10s. in 4 yr. at $3\frac{1}{2}\%$.

11. Amounts to \$1881.25 in 225 da. at 5% .

12. The amount of a certain principal was \$307.20 for $3\frac{1}{2}$ yr. and \$312 for $3\frac{3}{4}$ yr. Find the principal and the rate.

EXERCISE 134

1. Find the simple interest on \$275.60 from 18th July, 1911, till 13th September, 1912, at 6% per annum.
2. Find the interest on \$84.25 from April 16, 1908, to November 4, 1909, at 7% per annum (year=365 days).
3. A person borrows money for 6 yr. at $3\frac{1}{4}\%$, and repays at the end of the time as principal and interest \$847. How much did he borrow?
4. Find the interest on \$387.56 from March 18 to November 19 at 6% per annum.
5. A note of \$360, drawn April 20, 1911, is paid July 2, 1912, with interest at $7\frac{1}{2}\%$ per annum. Find the amount paid.
6. On June 29, 1909, I borrowed \$16.50, and returned it on April 30, 1910. With interest at $6\frac{1}{2}\%$, what amount did I then pay?
7. Bought a horse for \$160, and gave in payment my note dated August 15, 1911, with interest at $7\frac{1}{2}\%$ per annum until paid. On January 8, 1912, I sold the horse for \$200 cash, and paid my note. What was my net gain?
8. What amount will be due July 1, 1911, on a note of \$80 drawn February 6, 1911, bearing interest at $5\frac{1}{2}\%$ per annum?
9. On the 15th October, 1911, a young man deposited in a savings bank the sum of \$860.75. On the 20th May, 1912, he withdrew the principal and simple interest at 4% per annum. What amount did he withdraw?
10. On January 1, 1910, A borrowed \$1000 from B at 6% per annum. On July 1, 1911, he paid \$600. How much did A owe B on January 1, 1914, when he paid the debt, principal and interest?

EXERCISE 135

1. On May 15, 1908, a man bought a piano for \$500, agreeing to pay \$125 a year until it is paid for with interest at 6% per annum.

(a) Find the dates on which the various payments are due.

(b) Calculate the amount of each payment.

(c) When the piano is finally paid for, how much has it cost him?

2. A man borrowed \$1400 from a Loan Company on Feb. 1st, 1914, agreeing to repay the principal at the rate of \$140 at the end of each year with interest at 8% simple interest, payable half-yearly.

(a) How many years will it take to repay the loan?

(b) Calculate the amount of each payment.

(c) Find the total amount of interest he has paid during the period.

3. A school district on April 1st, 1912, borrowed \$1200 to defray the expense of building and equipping a school, agreeing to repay the principal in ten equal annual payments at $5\frac{1}{2}\%$.

(a) At what dates are the various payments due?

(b) Calculate the amount of each payment.

(c) Find the total amount of interest paid during the period.

4. A school district borrowed \$1200, the principal to be repaid in 8 equal annual payments at 6%.

(a) Find the amount of each payment.

(b) Find the total amount of interest paid.

5. A school district in Saskatchewan borrowed \$1000 on April 1st, 1913, agreeing to repay it in the following manner at 6%:—

\$100 in $\frac{1}{2}$ year—

\$100 in $2\frac{1}{2}$ year—

\$100 in $1\frac{1}{2}$ year—

\$100 in $3\frac{1}{2}$ year,

and so on until paid.

(a) Make a table showing the dates of payment, principal, interest and amount due on each date.

(b) Find the total amount paid during the period.

6. Make a similar table in the case of a loan of \$12 000 made on March 15th, 1913, payable in 15 equal annual payments, interest at 6%.

7. A school board in Saskatchewan received notice on March 1st, 1913, from a Loan Company, that the last payment of principal and interest on the loan of \$1000 to that district would be due on April 15th. If the loan was repayable in 10 equal annual payments at 6%, find—

- (a) The date on which the loan was made.
- (b) The amount of the payment due.

VII. BANKING AND BANK INTEREST

To facilitate the transaction of business, there are institutions called banks which deal in money and credit. They receive money from persons who wish to deposit it where it will be safe and can be obtained when it is needed. They also loan money on good security to merchants and others and also remit it from one place to another.

When money is deposited for a considerable time, it is usual for the bank to allow interest on the deposit. This branch of the bank is called the *Savings Bank Department* of the Bank.

When a deposit is made, the number of bills of each denomination, cheques, silver, etc., are entered on a credit slip similar to that shown on the opposite page.

To withdraw money from a bank, a cheque must be drawn by the person in whose name the money is deposited. The bank pays out the sum mentioned in the cheque to its legal holder and debits the sum to the depositor. (See page 136.)

Form 14 A

Folio.....

RÉGINA BRANCH

CREDIT

.....191

[illegible]

BANK CHEQUE

Regina, Sask. _____ *191* _____

IMPERIAL BANK OF CANADA

Pay to _____ *or bearer \$* _____
Dollars _____

EXERCISE 136

1. A customer enters a bank to deposit 8 one-dollar bills, 5 twos, 7 fives, 2 twenties, three cheques for \$24.85, \$32.85, and \$41, and \$8.37 in change. Fill in his deposit slip.
2. David Smith owes Thompson & Co. \$247.89 for work done. Smith draws a cheque on the Imperial Bank for this sum. Write out the cheque, supplying place and date.
3. A farmer having \$258.16 to his credit in a bank on April 30th, deposits \$17.36, \$24.84, \$72.96, \$36.45 during the month of May, and draws cheques for \$8.75, \$21, \$36.19 and \$11.37. Find his balance on May 31st.
4. Make out a deposit slip for the following:—25 one-dollar bills, 17 twos, 18 fives, 2 fifties, cheques for \$42.50, \$36.85, \$17.28, \$47.50, and silver \$14.25.
5. John Morrison of Regina owes the Massey-Harris Company \$275 on account. He draws his cheque on the Bank of Montreal on May 8, 1913, for this sum. Write the cheque.
6. A merchant's deposits during the week have been \$125.32, \$117.84, \$203.16, \$175.15, \$204.15, \$184.25. He has given cheques for \$46.75, \$24.84, \$36.15, and \$29.40. At the beginning of the week his bank balance was overdrawn \$24.36. Find his balance at the end of the week.

VIII. BANK DISCOUNT

A merchant desires to obtain a loan of \$1000 for 60 days; he makes a note, in the form given below, has it *endorsed* or guaranteed by some reliable person, takes it to the bank which deducts the interest on \$1000 for 63 days, at a certain rate which varies from time to time, gives him the *proceeds*, and collects the \$1000 at the end of the 63 days.

The 3 days added to the specified time are called *days of grace*, which must elapse before payment can be *legally* enforced.

49. *Bank Discount* is, therefore, simple interest collected in advance upon the sum on a note at its maturity.

EXERCISE 137

\$350.86.

Toronto, July 25th, 1914.

Three months after date, for value received, I promise to pay William Robinson, or order, three hundred and fifty $\frac{86}{100}$ dollars at the Dominion Bank.

James Thompson.

Discounted August 1st, 1914, at 6%.

1. For what sum was this note drawn? (\$350.86; this is called the *face of the note*.)

2. When did the note become legally due? (Aug. 10; this date is known as the *Maturity of the note*.)

3. How many days elapsed between the time of discounting the note and the time of maturity? (70 days; this is the *term of discount*.)

4. After June 1st, who has legal possession of the note? (Dominion Bank; this is said to be the *holder of the note*.)

5. Calculate the interest on \$350.86 for 70 days at 6% per annum.

(Interest = $\frac{70}{360}$ of $\frac{6}{100}$ of \$350.86 = \$4.04; this is the *Bank Discount*.)

6. Find how much Robinson received from the bank for the note. (\$350.86 - \$4.04 = \$346.82; this is called the *proceeds of the note*.)

EXERCISE 138

Find (1) the date of maturity, (2) the term of discount, and (3) the proceeds of the following notes:

Date of Note	Face of Note	Time	Discounted	Rate
1. April 21, 1913	\$500	3 mo.	May 5	6%
2. Sept. 15, 1913	\$400	4 mo.	Sept. 15	7%
3. Jan. 25, 1913	\$657	3 mo.	Feb. 14	7½%
4. May 11, 1913	\$511	4 mo.	July 31	6%
5. June 20, 1913	\$116.80	60 da.	June 28	8%

6. Draw a note due in 3 mos. payable to Wm. Preston, or bearer, at the Canadian Bank of Commerce, Winnipeg.

7. What is the bank discount and net proceeds of a note for \$584, drawn Jan. 8 at 11 months, discounted at the bank May 10, at 5%?

8. What is the bank discount on a note for \$730 at 6% for 30 days, days of grace included?

9.

\$800.

Calgary, March 30, 1914.

Six months after date, I promise to pay James Taylor, or order, eight hundred dollars, with interest at $7\frac{1}{2}\%$ per annum. Value received.

T. D. Jones.

(a) When is this note nominally due?

(b) When is it legally due?

(c) What will the note amount to at maturity?

(d) How much will Mr. Taylor receive for it if he takes it on the day of making to a bank and has it discounted at 9% per annum?

10. Suppose a bill for \$1200 is drawn on the 12th of August at 6 months, and paid by a banker on the 1st of January, find the money he takes off at 7%.

EXERCISE 139

1. I owe a bill amounting to \$73.25, and I give my note for 90 days; how must I draw it to cover the discount at 7%?

2. A. B. has a note of \$1000 to pay at the Imperial Bank. At the time of its maturity he pays \$300 and gives a note for 3 months, days of grace included, for the balance. The rate of discount being 8% per annum what was the face of the note?

3. Discounted the following note 4 months, days of grace included, before it was due at the Bank of Montreal at 9% per annum. What did I receive for it?

\$500.

Toronto, Jan. 1, 1914.

One year from date I promise to pay K.L. the sum of five hundred dollars with interest at 8% per annum for value received.

D.E.

4. A note for \$1750 was drawn on Aug. 10 for 4 months. It was discounted on Oct. 1, at the Dominion Bank, at $7\frac{1}{2}\%$ per annum. What sum was received for it?

5. The bank discount on a note for 3 months at $7\frac{1}{2}\%$ per annum is \$3.45. Find the face of the note.

6. A note is drawn for 3 months, days of grace included, and when discounted at $6\frac{1}{4}\%$ per annum at the Union Bank it realizes \$5.25 less than its face value. What is the face value of the note?

Suppose a merchant doing business in Toronto is indebted to another in Winnipeg, it is usual for the latter to *draw* on the former, i.e., he instructs the Toronto merchant to pay the sum into a bank which remits it to him in Winnipeg.

DRAFT.

\$500.

Winnipeg, May 1, 1914.

AT SIGHT pay to the order of The Traders Bank, Five hundred $\frac{00}{100}$ dollars, value received, and charge the same to the account of

To Wm. Dills, Esq.,
Merchant,

James Smith.

Toronto.

James Smith, the person who makes the draft, is the *Drawer*.

Mr. Dills, who pays the draft, is called the *Drawee*.

The Traders Bank, to whom the money is directed to be paid, is the *Payee*.

EXERCISE 140

1. John Brown, of Calgary, owes Rutherford & Co., of Regina, \$1000. Rutherford & Co. draw on Brown through the Bank of Commerce. Write out the draft.

2. In the draft mentioned in Question 1, who is the Drawer? Who is the Payee? Who is the Drawee?

3. A note for 73 days (days of grace included), for \$250 was discounted at 8% per annum. Find the proceeds of the note.

4. A banker charges me \$30 discount on a note of \$1200 due in 40 days. Find the rate per cent. per annum he charged.

5. The proceeds of a note due in 90 days, discounted at 7½% per ann., are \$573.20. Find the face of the note.

6. A banker discounts a note of \$250 at 10% per ann. and charges \$10. For how long was the discount computed?

7. Fill in the blanks:

Face of Note	Proceeds	Date of Note	Time	Date of Discount	Rate
\$584	.....	May 7	3 mo.	May 29	10%
\$730	\$718.32	Oct. 20	4 mo.	Dec. 12	.....
\$703.80	.....	Dec. 18	4 mo.	.....	73 da.
\$1962.45	\$1926.70	.....	4 mo.	Aug. 26	6%
\$657	\$645.48	.....	3 mo.	May 1	7%
					8%

IX. COMPOUND INTEREST

50. If *A* borrowed \$1000 from *B* and has agreed to pay interest at the rate of 6% per annum, at the end of each year, *B* should receive \$60 from *A* until the principal is repaid. If, however, *A* does not pay the \$60 to *B* at the end of the first year, it is clear that he

has now the use of \$1060 of *B*'s money and he should pay interest on this sum for the second year. Hence the interest for the second year will be \$63.60. Interest reckoned not only for the use of the sum borrowed, but also for the use of the interest if it be not paid when it falls due, is called *Compound Interest*.

Example 9. A man deposited \$2500 in a savings bank, the interest being added to the principal every 6 months at 4% per annum. How much was at his credit at the end of 18 mo.?

Original principal.....	\$2500
Interest for 1st 6 mo. at 2%.....	50
Principal for 2nd period.....	\$2550
Interest for 2nd 6 mo. at 2%.....	51
Principal for 3rd period.....	\$2601
Interest for 3rd 6 mo. at 2%.....	52.02
Sum at his credit.....	\$2653.02

EXERCISE 141

Find the compound interest and the amount of:

1. \$1000 for 2 yr. at 5%, compounded annually.
2. \$2500 for 3 yr. at 6%, compounded annually.
3. \$2500 for 1½ yr. at 8%, compounded half-yearly.

Find the difference between the simple and the compound interest on the following:—

4. \$1000 for 3 yr. at 6%, compounded annually.
5. \$2500 for 18 mo. at 4%, compounded half-yearly.
6. \$2500 for 1 yr. at 8% compounded quarterly.
7. What is the compound interest of \$650 for 3 years at 6 per cent., interest being compounded annually?
8. Find the difference between the simple and compound interest of \$350 for 3 years at 8 per cent., interest being compounded annually.

9. A sum of money put out at simple interest for 2 years at 8 per cent. amounted to \$464; to what sum would it have amounted had it been lent at compound interest?

10. The simple interest on a sum of money for 3 years at 8 per cent. is \$120; what is the compound interest of the same sum for the same time?

11. A man deposits in the savings bank \$500, on which the interest at 4 per cent. per annum is to be added to the principal every 6 months; how much money has the man in the bank at the end of two years?

X. GENERAL REVIEW

EXERCISE 142

1. What is the cost of $93\frac{3}{4}$ a. of land, if $18\frac{3}{4}$ a. cost \$1200?

2. If a pole 25 ft. in height casts a shadow 20 ft. long, find the length of the shadow cast by a steeple 200 ft. in height.

3. If a postage stamp is 1 in. long, and $\frac{1}{2}$ in. broad, how many will be required to paper a table 6 ft. long and 3 ft. 8 in. wide?

4. If \$308.75 will buy $4\frac{3}{4}$ a. of land, how much will $7\frac{1}{2}$ a. cost at the same rate?

5. It cost Wm. Smith \$2862 to pay .75 of a debt. What was the amount of the debt and how much did Mr. Smith still owe on it?

6. If the taxable valuation of a city is \$92700000, what sum will be raised by a rate of 17.5 mills on the dollar?

7. Teas costing \$1.20, \$1.40, and \$1.50 a pound are sold at \$1.50, \$1.70 and \$1.80 a pound respectively. Find the gain per cent. on each.

8. A man owning $\frac{1}{16}$ of a store, sold 45% of his share for \$6930. What part of the whole did he sell, and how much was the whole worth?

9. A speculator invested $62\frac{1}{2}\%$ of his estate in a mine and deposited the remainder, \$5400, in a bank. Find the value of his estate and how much he invested in the mine.

10. A wagon wheel is 14 ft. 6 in. in circumference. How many revolutions will it make in going 9 miles?

11. If a laborer saves \$25 in four weeks, how long will it take him to save \$187.50?

12. Express 9 cu. yd. 6 cu. ft. as the decimal of a cord.

13. Express CD IV as the fraction of $MC \times 4$ in its lowest terms.

14. How many board feet are there in a stick of timber 30 ft. long, 1 ft. wide and 15 in. deep?

15. Simplify $(\frac{2}{3} + 4\frac{1}{2} - 2\frac{3}{8}) \times 4\frac{1}{4} + 3\frac{1}{2}$.

16. How many yards of carpet $\frac{3}{4}$ yd. wide will cover a room 36 ft. long and 24 ft. wide?

17. What sum must be paid to discharge a debt of \$1728 due 15 mo. hence, interest being at $7\frac{1}{2}\%$ per ann.?

18. A man sells 22 articles for the same money as he paid for 36. Find his gain per cent.

19. Discounts of 25, 10, and 5% are allowed off a purchase of goods. What sum will settle for a purchase of \$360?

20. Three pipes empty a vessel in 6, 4 and 2 hrs. respectively. How long will they take, running together?

21. Divide .007764 by 1.25, using short division.

22. What fraction, multiplied by the sum of $\frac{2}{3}$, $1\frac{1}{2}$, and $\frac{1}{7}$, will make the product 3?

23. Divide \$168 between two men, so that one may have three-fifths of what the other has.

24. At \$72 an acre, what is the value of a rectangular field $28\frac{1}{2}$ ch. long and 24.4 ch. wide?

25. At \$6.50 a cord, what is the value of a pile of stone 24 ft. 6 in. long, 12 ft. 4 in. wide, and 6 ft. 6 in. high?

26. A bill of goods on which a discount of 8% was allowed was settled for \$414. Find the amount of the bill.
27. Write a note for the following:—I borrow of Fred. Thomas \$640 payable to himself in 4 mo. at 8% .
28. A merchant placed 75% of his year's profits in a bank; having drawn out 25% of his deposit, \$2700 remained. What were his profits for the year?
29. A farmer thrashed 5780 bu. of wheat and sold 4913 bu. What per cent. of his wheat did he sell?
30. A merchant mixed 9 lb. of black tea at 64c. with 11 lb. at 72c. At what price per pound must he sell the mixture to gain 25% ?
31. If 1.7 bu. of walnuts cost \$1.80, find the cost of 5.95 bu.
32. Into a rectangular cistern, the bottom of which is 8 ft. by 6 ft. water is pouring at the rate of 500 gal. per hour. How long will it take to fill the cistern to a depth of 5 ft.?
33. A farmer bought two farms of 150 a. each for \$26000. What was the cost of an acre of each, if 2 a. in one cost as much as $2\frac{1}{2}$ a. in the other?
34. A father gave his son \$24. This was $66\frac{2}{3}\%$ of what the father had left. How much money had the father at first?
35. Find all the common measures of 924 and 2520.
36. Of what number is .875 both divisor and quotient?
37. A house valued at \$2500 is insured for $\frac{3}{4}$ of its value. The premium for three years is \$18.75. Find the rate of insurance.
38. When the rate of taxation is reduced from $18\frac{1}{2}$ mills on the dollar to $16\frac{1}{4}$ mills, A's taxes are \$9 less. Find the amount of A's assessment.
39. The difference between the Simple and the Compound interest on a certain sum of money for 2 yrs. at 8% is \$6.40. Find the sum.

40. The product of three numbers is 8544183; two of the numbers are 87 and 109. Find the third number.

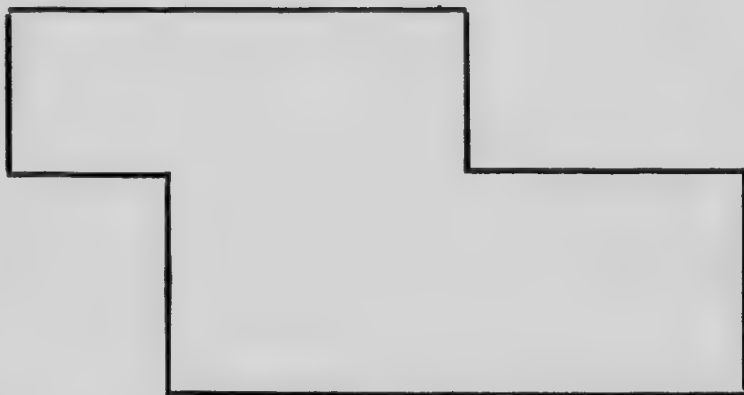
41. A train goes 94.27 mi. in 2 hr. 45 min. Find its average rate per hour.

42. Divide \$3080 between two men, so that one may receive $\frac{1}{4}$ as much as the other.

43. If 2 turkeys and 3 geese are bought for \$9.35, and 2 geese and 3 turkeys for \$10.65, find the price of a turkey and the price of a goose.

44. If $4\frac{1}{2}$ lb. of tea cost \$1.98, find the cost of $8\frac{1}{2}$ lb.

45. Find the area of the following farm,—scale 1 in. to 40 rd.



46. Two years ago the population of a certain place was 575. It is now 920. Find by how much per cent. the population has increased.

47. What must be the market price of goods that cost me \$2.70, so that I may reduce my price by 10% and still make 20% profit?

48. (a) Make out the following account neatly, accurately, and in proper form:—John Wilson bought from you to-day, $7\frac{1}{2}$ lb. cheese at 12c. per pound, $6\frac{1}{2}$ lb. butter at 23c. per pound, $2\frac{1}{2}$ lb. tea at 55c. per pound, 27 lb. sugar at \$1 per 12 lb.

(b) He paid you cash and you allowed him 5% off.

(c) Receipt the account.

49. The average of 7 numbers is 26.98. The average of the first two is 34.5, and of the next three 19.3. Find the average of the remaining two.
50. The value of an equal number of half-crowns, shillings, pence, and farthings is £3 12s. 1d. How many are there of each coin?
51. Divide £2 19s. 0 $\frac{1}{2}$ d. between *A* and *B*, giving to *B* half as much more as to *A*.
52. Find the cost of gilding the entire outside surface of a covered box 3 ft. long, 2 ft. 6 in. wide, and 1 ft. 9 in. deep, at \$1.20 per square foot.
53. One blackboard in the school is 4 ft. wide and 16 ft. long; the other is 3 $\frac{1}{2}$ ft. wide and 24 ft. long. How many feet must be cut off the length of the larger blackboard so that the remainder will have the same area as the smaller one?
54. In a factory the men receive \$10 a week; 4 times as many women, \$9 a week; and 10 times as many boys, \$5 a week. What is the average wages of each?
55. Divide \$2900 among *A*, *B*, and *C*, so that 7 times *A*'s share, 4 times *B*'s and 8 times *C*'s are all equal.
56. A drover bought 6 head of cattle, the average price being \$50 a head. Four actually cost \$32, \$35, \$48, and \$55, respectively. Find the cost of each of the others, one costing \$5 more than the other.
57. A coal dealer buys 80 t. of coal, retails it at 36c. a bag, and gains \$20. Had he sold it at 32c. a bag, he would have lost \$30. Find the weight of a bag of coal.
58. In a boat race of half a mile, one boat gains 5 ft. every 55 yd. By how much does this boat win?
59. How many seconds will it require a train 76 yd. long, travelling 30 mi. per hour, to clear 100 yd.?
60. If 13 geese are worth as much as 7 turkeys and a turkey is worth \$1.30, what will 42 geese and 13 turkeys be worth?
61. Divide \$25 among *A*, *B*, and *C*, giving *A* \$1.60 more than *B*, and *B* \$1.80 more than *C*.

62. What will 3 lb. 1 oz. 12 dr. of an article cost, if 17 lb. 1 oz. 10 dr. cost \$176?

63. Two pieces of cloth of the same length cost \$26.82 and \$34.56, respectively. The price of the first piece was $74\frac{1}{2}$ ¢. per yard. Find the price of the second piece per yard.

64. In dividing a number successively by 6, 7, 8, the remainders are 4, 5, 7, respectively. Find the whole remainder.

65. How much water must be added to a cask of 60 gal. of wine, at \$2.50 per gallon, to reduce the price to \$1.60 per gallon?

66. *A* and *B* earn \$4.62 in 7 days; *A* and *C*, \$7 in 10 days; *B* and *C*, \$8.36 in 11 days. How much does each earn per day?

67. A jeweller bought a number of watches for \$2790, and sold part of them at \$40 each for \$1120, losing \$140 on those sold. At what price each must he sell the remainder in order to make a total gain of \$200?

68. Find the number of posts required for a fence 136 feet long if the posts are placed 8 feet apart.

69. A man owning a corner lot $128' \times 56'$ decides in fencing it to leave the street sides open. If the posts are placed 8 feet apart and cost 25 cents each, and the cost of digging the post holes is 10 cents each, what will it cost to buy and fix the posts in the ground?

70. Find the number of posts placed 10 feet apart required for a fence around a lot $50' \times 100'$. Find their cost at 20 cents each.

71. Find the total cost of building a tight board fence 150 feet long, 6 feet high, the boards being nailed to two rows of $2'' \times 4''$ scantling, lumber being worth \$32 per M. The posts are placed 10 feet apart and cost 30 cents each.

72. If in number 69 the fence is tight board 5 feet high and boards are nailed to two rows of $2'' \times 4''$ stringers, find the entire cost of the fence, lumber being worth \$28 per M.

73. A man exchanged 638040 lbs. of wheat worth 48½c. per bu.; 9037 lbs. of oats worth 19 cents a bushel, and 7391 lbs. barley worth 48c. a bushel, for potatoes worth 49 cents a bushel; how many bushels of potatoes did he receive?

74. What is meant by "per cent."? What is the percentage of attendance in a school having an enrolment of 59 pupils and school being open 20 days, there being 3 pupils absent 3 days each, 2 pupils absent 5 days each and 1 pupil absent 10½ days?

75. Which is the more nearly correct and by how much?

$$(a) \frac{10}{9.009} = 1.11; \text{ or } (b) \frac{10}{1.11} = 9.009?$$

76. An agent sold cotton amounting to \$6398.56 and collected a commission of 2½ per cent. He invested the net proceeds in dry goods after deducting his commission of 1½% on amount so expended. Find his total commission.

77. A man sold oxen at \$28 each, cows at \$17 each and sheep at \$7.50 each and received \$749 for the lot. There were twice as many cows as oxen and three times as many sheep as cows. How many of each kind were there?

78. A plate of metal 3½ inches thick and 21 feet long is formed into a hollow cylinder having an outer circumference of 3 feet 8 inches. What will it cost to paint its lateral surfaces at 15 cents a square foot?

79. The west-bound passenger train running at an average speed of $22\frac{1}{2}$ miles per hour, including stoppages, leaves Brandon at 21.50 o'clock and arrives at Moose Jaw on the following day at 9.55 o'clock. If Brandon is 132 miles from Winnipeg, find the distance of Moose Jaw from the latter place.

80. The product of two numbers is 908.2009. If one of the numbers is 1.009 find the product of the sum and difference of the numbers.

81. A dealer in Moosomin buys 12000 bushels of oats by measure at 24 cents per bushel. He sells them at Revelstoke at \$24 per ton after paying 40c. per cwt. for freight to their destination. The oats originally weighed 40 lbs. to the bushel but when weighed at Revelstoke they were found to have lost $7\frac{1}{2}\%$ in weight. If the other expenses in connection with the transaction amounted to \$384, find the dealer's gain or loss per cent.

82. Two carpenters took the contract of building a bridge for \$1600. The material cost \$644 and the extra labor \$130. One of them works 42 days of 8 hours each, and $12\frac{1}{2}$ days of 10 hours each. The other works 30 days of 8 hours each, and $12\frac{1}{2}$ days of 10 hours each. If they divide the proceeds, after paying for the material in proportion to the time each works, to what amount will each be entitled?

83. Find the value of 5 yds. of lace if $12\frac{1}{2}$ metres cost $87\frac{1}{2}$ francs. A franc = 19.5 cents; 1 in. = .0254 metres.

84. A corral 53 yds. is 1 ft. long and 40 yards wide is surrounded by a close board fence 5 ft. 6 in. high, nailed to two rows of scantling. The lumber used is $1\frac{1}{2}$ inches thick and the scantling are 4 in. wide and 2 in. thick.

(a) Find the value of the lumber at \$30 per M.

(b) Find the area and the circumference of the largest circular pen that may be made in the yard after allowing 4 ft. on each side.

(c) Find the distance diagonally across the corral.

85. Solve: (a) $(847)^3$; 687241^2

(b) $(0.075)^2 - (0.005)^2$

$0.75 - 0.05$.

86. A and B enter partnership for 2 years, A at first putting in \$2500 and B \$3000. At the end of 9 months A took out \$800 and B put in \$500. At the end of two years they had lost \$3825. What was each one's share of the loss?

CHAPTER VII

SHARING, PROPORTIONAL PARTS, OR DISTRIBUTIVE PROPORTION

I. SHARING AND PARTNERSHIP

EXERCISE 143

INTRODUCTORY

John Smith and David Jones agree to carry on business together and share the profits and the losses in proportion to the sum of money each has in the business.

If Smith puts in \$2000 and Jones \$2000, how should a profit of \$500 be shared?

If Smith puts in \$2000 and Jones \$3000, how should a profit of \$500 be shared?

51. An association of two or more persons in business with an agreement to share the profits and losses is a *Partnership*.

52. The Association is called a *Firm* or *Company*.

53. The persons associated are the *partners*.

54. The money or property invested in the business is the *Capital* or *Stock*.

EXERCISE 144

1. Divide 198 into two parts proportional to 4 and 7.

2. Divide 198 into three parts proportional to 5, 6, and 7.

3. The sum of two numbers is 1260, and they are to each other as 57 and 48. What are the numbers?

4. Divide \$500 among three persons, *A*, *B*, and *C*, so that the three portions may be to each other as the numbers 5, 9, and 6, respectively.

5. A bankrupt has three creditors, to whom the sums due are as the numbers 3, 4, and 5. If his assets are valued at \$600, find the sums they will respectively receive.

6. Divide 540 into three parts proportional to 3, $3\frac{1}{2}$, and 7.

7. Divide 915 into five parts proportional to 1, 2, 3, 4, and 5.

8. Divide 1815 into three parts which shall be to each other as $2\frac{1}{2}$, $3\frac{1}{2}$, and $4\frac{1}{2}$.

9. Three brothers raise 510 bu. of potatoes. How many bushels did each raise, if their amounts are to each other as 9, 10, and 11?

10. A farmer shipped a carload of wheat and oats containing 875 bu. in parts proportional to $\frac{1}{2}$ and $\frac{1}{3}$. Find the number of bushels of each.

11. In a certain school 48% of the pupils are boys and there are 39 girls. Find the number of boys.

12. A certain sum of money was divided among *A*, *B*, and *C*, so that *A* received half as much again as *B*, *C* received $\frac{2}{3}$ of the sum given to *A* and *B* together. If *C*'s share was \$132, find the sum divided.

EXERCISE 145

1. *A* and *B* engage in a wholesale business. *A* invests \$6000 to *B*'s \$4000. They gain \$1250. What is each one's share of the gain?

2. *A*, *B*, and *C* buy a house for \$2500; *A* pays \$500, *B* \$1200, *C* \$800; they rent it for \$300. What is each one's share of the rent?

3. A man dying, willed to his son \$6500, to his widow \$8000, and to his daughter \$5500; but his estate amounted to only \$12000. How much did each get?

4. *A* and *B* jointly rented a pasture for \$24; *A* put in 36 cows, and *B* 24 cows. How much of the rent ought each to pay?

5. *A*, *B*, and *C* hired a carriage for \$15.75, each agreeing to pay in proportion to the number of miles he rode. *A* rode 90 mi., *B* 75, and *C* 60 mi. What part of the hire ought each to pay?

6. *A* and *B* were engaged in business two years, making an annual profit of \$8190. *A* owned $\frac{2}{3}$ of the stock. What was each partner's share of the total profit?

7. *A*, *B*, *C*, *D*, formed a partnership with a capital of \$30000. *A* furnished \$6000, *B* \$7000, *C* \$8000, and *D* the remainder. They gained 18% of the joint stock. What was each partner's share of the profit?

8. *A*, *B*, and *C* carry on a coal business. *A* invests \$8500, *B* \$9000, and *C* \$12000. At the end of the year *B*'s share of the gain is \$4050. Find the total gain.

9. Three men engaged in business. *A* received \$90, *B* \$115, and *C* \$148 of the gain. *C*'s capital was \$740. What was the total capital?

10. *A*, *B*, and *C* enter into partnership. *A* invests \$700 and receives \$105 as his share of the gain. *B* invests \$580, and *C*'s share of the profits is \$48. Find *B*'s profits and *C*'s capital.

11. *A*, *B*, and *C* are partners in a business in which *A* has invested \$5000, *B* \$3000, and *C* \$2500. *C* receives $12\frac{1}{2}\%$ of the profits as manager; the remainder is divided among them all in proportion to the capital of each in the business. What does each receive of \$840 profit?

12. The cargo of a ship was worth \$25000 and was insured for \$17500. If the cargo belonged to *A*, *B*, and *C* in proportion to 1.4, 1.5, and 1.6, respectively, how much would each lose in case the vessel was lost?

13. In a mixture of 360 gal. of wine and water, there is 1 qt. of water to every gallon of wine. How many gallons of each are there in the mixture?

14. Divide \$9282 among *A*, *B*, *C*, and *D*, giving to *A* 10% more than to *B*, to *B* 10% more than to *C*, and to *C* 10% more than to *D*.

15. There are three books *A*, *B*, and *C*. *A* and *B* together contain 900 pages; *B* and *C* together 845 pages; and *C* and *A* together 1025 pages. How many pages are there in each book?

16. *A*, *B*, and *C* enter into partnership. *A* puts in \$10500, *B* \$7500, and *C* \$13500. The total gain is \$4725. What per cent. of this should *A* receive?

17. *A*, *B*, and *C* rent a pasture for a season for \$38. *A* puts in 30 sheep for 13 weeks; *B* 24 sheep for 15 weeks and *C* 20 sheep for 10 weeks. How much of the rent should each pay?

EXERCISE 146

1. Divide \$1117.60 among *A*, *B*, and *C*, so that *A* may have twice as much as *C* and *B* \$10 more than three times as much as *C*.

2. A man spent \$240.25 in cloth at \$1.55 a yard, and sold it to 3 men. The first man bought 35 yd. more than 3 times the second one and 20 yd. less than the third man. Find each share.

3. A man sold 3 sheep for \$37; for the first he received \$3 more than for the third, and \$4 less than for the second. What did he get for each?

4. The cost of a quantity of silk at \$3.25 per yard, and tweed at \$2.50 per yard, was \$409.75, the whole cost of the tweed being 25c. more than that of the silk. Find the number of yards of each kind of cloth.

5. The cost of 12 bu. of oats and 17 bu. of wheat was \$14.97. The cost of a bushel of wheat was 42c. more than that of a bushel of oats. Find the cost of a bushel of wheat.

6. Mary has two dollars in five and ten-cent pieces. The number of ten-cent pieces is two more than the number of five-cent pieces. How many of each kind has she?

7. A farmer employs a number of men and 8 boys; he pays the boys 65c. and the men \$1.10 per day. The amount that he paid to all was as much as if each had received 92c. per day. How many men were employed?

8. The quantity $93\frac{1}{2}$ is the sum of a certain number of ninths, three times as many tenths, and five times as many twelfths. What are the values of the three aggregate parts of the quantity?

9. A farmer bought a number of horses and cows for \$2000. There were three times as many cows as horses, and a horse cost twice as much as a cow. If each horse cost \$80, how many cows did he buy?

10. Divide $45\frac{1}{2}$ bu. between *A* and *B*, so that when *A* gives *B* $\frac{1}{3}$ of his (*A*'s share), their shares may be equal.

II. AVERAGES

EXERCISE 147

1. Find the aggregate and the average of the following:

(a) 250, 306, 402, 211, 309.

(b) $7\frac{1}{2}$, $3\frac{1}{4}$, $4\frac{1}{2}$, $5\frac{1}{8}$, $7\frac{1}{4}$.

(c) 7.5, 5.34, 8.75, 3.48, 6.23.

2. The school register shows that 34 pupils were present on Monday, 32 on Tuesday, 35 on Wednesday, 33 on Thursday, and 36 on Friday. Find the average attendance during the week.

3. The elevation of certain places above the sea level is as follows: find their average elevation:

(a) Calgary	3410 ft.	Red Deer	2806 ft.
Summit	3627 ft.	Battle River	2627 ft.
Olds	3402 ft.	Edmonton	2188 ft.
(b) Fernie	3302 ft.	Crow's Nest Lake	4424 ft.
Michel	3853 ft.	MacLeod	3128 ft.
Crow's Nest	4438 ft.	St. Mary's River	2795 ft.
(c) Winnipeg	757 ft.	Virden	1444 ft.
Portage la Prairie	854 ft.	Wolseley	1950 ft.
Carberry	1258 ft.	Indian Head	1924 ft.
Brandon	1194 ft.	Regina	1885 ft.

4. What number substituted for each of the addends 36.2, 18.5, 27.3, 36.4, 25.2, will give the same sum?
5. The aggregate of 6 boys is 465 lb. The average weight of four of them is 79.5 lb. Find the average weight of the remaining two.
6. A farmer received \$17.40 for 8 turkeys which he sold at 15c. a pound. Find the average weight of a turkey.
7. Six boys weigh on the average 115 lb. One weighs 135 lb. Find the average weight of the other five.
8. Find the average length of four boards which are 12 ft. 6 in., 14 ft. 4 in., 16.6, and 16 ft.
9. Eight blocks of granite weigh as follows:—17.4 cwt., 18.5 cwt., 15.8 cwt., 12.75 cwt., 14.25 cwt., 16.3 cwt., 15.5 cwt., and 18.2 cwt. Give their average weight in pounds.
10. In a cricket match the scores of one side were the following:—0, 24, 10, 32, 0, 0, 6, 8, 2, 6. Find the average score per man.
11. The mean height of five mountains is 7850 ft. and the mean height of 4 of them is 5912 ft. Find the height of the fifth mountain.
12. A grocer sold 3 lb. of tea at 75 cents per lb. and 2 lb. at 50 cents per lb.; what was the average price?
13. Two purchases have been made of 15 lb. weight at \$2.50 per lb., and 25 lb. at \$1.80 per lb. What is the average price per lb.?
14. The average temperature of the different months during the past 37 years at Toronto was: of Jan. 22°.94, Feb. 22°.58, March 29°.05, April 40°.63, May 51°.68, June 61°.84, July 67°.43, Aug. 66°.32, Sept. 58°.10, Oct. 45°.74, Nov. 36°.03, Dec. 25°.57. What was the average yearly temperature during that period?
15. In a class there were six boys whose respective heights were 4 ft. 5 in., 4 ft. 6 in., 5 ft., 4 ft. 7½ in., 4 ft. 9½ in. and 4 ft. 1½ in. What was the aggregate of their heights and what their average height?

16. A mixes 25 gal. of water with 125 gal. of vinegar, which cost him 40 cents per gallon. How much must he charge per gallon so as to make a profit of $33\frac{1}{3}$ per cent?

17. I bought 475 barrels of flour, part at \$6.50 per barrel and the rest at \$6.75. The average cost per barrel was \$6 $\frac{1}{3}$. How many barrels at each price were bought?

18. A mixture of gold and silver weighs 15 oz. and is worth \$128, but if the proportions of gold and silver be reversed, it is worth \$142. Gold being worth \$16 per ounce, find the price of silver per ounce.

19. The average price paid for a farm of 320 a. was \$16.25; 80 a. cost \$2240; 160 a. cost on the average \$12.50. Find the average cost of the rest of the farm.

20. A farmer sold 125 head of cattle at \$36 per head, 142 head at \$42.50, and 238 head at \$45. Find the average price he received for them.

III. RATIO AND PROPORTION

EXERCISE 148

INTRODUCTORY

1. John has \$10; James has \$5. John has how many times as much money as James?

2. What is the relation of a line 3 in. long to one 1 mi. long?

3. How many times 5 is 20?

4. A quart is what part of a gallon?

5. How many pecks make a bushel?

6. What is the relation of \$24 to \$6?

The relation of one quantity to another similar quantity in respect to size is called the ratio of the two quantities.

7. (a) An hour is what part of 2 hr.?

(b) What is the ratio of 1 hr. to 2 hr.?

8. What is the ratio of the following:—

(a) 8 to 16?

(d) 24 mi. to 6 mi.?

(b) \$15 to \$5?

(e) \$12 to \$36?

(c) \$20 to \$10?

(f) 18 marbles to 3 marbles?

9. How is the ratio of two quantities found? The first of the two quantities is called the *Antecedent*, the second the *Consequent*.

Ratio is usually indicated by placing a colon between the two quantities. Thus the ratio of 8 to 4 is written 8:4 and is read 8 is to 4.

Ratio is also expressed by the sign of division: thus, $8 \div 4$.

It is also expressed by writing the numbers in the form of a fraction: thus $\frac{8}{4}$;

Hence 8:4, $8 \div 4$, and $\frac{8}{4}$ all denote the same relation.

10. Name the antecedent and the consequent of the following ratios:—

- | | |
|------------------|------------------|
| (a) 9 mi.: 3 mi. | (d) 3 qt.: 4 qt. |
| (b) 15:3. | (e) 5 ft.: 7 ft. |
| (c) \$18:\$9. | (f) 3 yd.: 2 ft. |

11. Express the ratio of the following quantities:—

- | | |
|---------------------|--|
| (a) \$6 to \$18. | (d) 16 lb. to 3 lb. |
| (b) \$4 to \$20. | (e) 15 apples to 5 apples. |
| (c) 5 hr. to 30 hr. | (f) $2\frac{1}{2}$ to $1\frac{1}{2}$. |

12. Supply the missing term in the following:—

- | | |
|-------------------------|-----------------------------|
| (a) 36: ? = 4. | (d) $4\frac{1}{2}$: ? = 3. |
| (b) ? : 12 = 7. | (e) ? :: 1 = 10. |
| (c) 72 hr.: 9 hr. = ? . | (f) ? : 5 = .04. |

13. The ratio of 8 to 4 is the same as the ratio of 12 to what number?

14. Find a number that will bear the same ratio to 12 that 5 bears to 15.

15. The ratio of 20 to 5 is equal to the ratio of 24 to what number?

16. Find a fourth term for the following ratios:—

- | | |
|-------------------|---|
| (a) 36:12=6: ? . | (d) 5:8 =25: ? . |
| (b) 56:7 =24: ? . | (e) $1\frac{1}{2}$: $\frac{1}{2}$ =21: ? . |
| (c) 25:5 =55: ? . | (f) 54:9=72: ? . |

55. When four quantities are so arranged that the ratio of the *first* to the *second* equals the ratio of the *third* to the *fourth*, the four quantities form a *Proportion*.

56. A Proportion is usually indicated by writing a double colon (::) between the equal ratios. Thus, $8:6::12:9$.

57. The *first* and *fourth* terms of a proportion are the *Extremes*; the *second* and *third* terms are the *Means*.

17. Name the extremes and the means in the following proportions:—

(a) $25:7::50:14$.

(b) $36\text{ hr.}:7\text{ hr.}::72\text{ mi.}:14\text{ mi.}$

18. In the following proportions, compare the product of the extremes with the product of the means:

(a) $7:5::14:10$.

(b) $84:12::21:3$.

(c) $12:24::36:72$.

19. In a proportion, how does the product of the means compare with that of the extremes?

20. Find the omitted term in the following:—

(a) $12:6::4:?$

(b) $35:6::4:?$

(c) $5:8::10:?$

EXERCISE 149

Example 1. Find the cost of 12 lb. of sugar, if the cost of 4 lb. is 25c.

The ratio of 12 lb. to 4 lb. is 3, hence 12 lb. will cost 3 times as much as 4 lb., or 75c.

1. If it requires 250 lb. of coal to run an engine for 6 hr., how much coal will be required to run this engine for 9 hr.?

2. If a pole 18 ft. high casts a shadow 25.5 ft. long, how long a shadow will be cast by a pole 31.5 ft. high?

3. If 156 bu. of wheat are required to make 44 bbl. of flour, how many bushels will be required to make 77 bbl.?
4. If John's money is to Henry's as 4 to 5, and Henry has \$20, how much has John?
5. If 60 sheep were sold for \$450, how much should 96 sheep bring at the same rate?
6. If \$360 gains \$28 in a given time, how much will \$900 gain the same time?
7. If 24 men can dig a ditch in 5 days, in how many days can 36 men dig a similar ditch?
8. If $\frac{3}{4}$ yd. of cloth costs \$7, find the cost of $\frac{5}{8}$ yd.
9. If 120 men earn \$2000 in a given time, how many men will earn \$2500 in the same time?
10. If 32% of an estate is worth \$5200, how much is 75% of the estate worth?
11. How far can a man walk in 12 da. of 8 hr. each, if he can walk 189 mi. in 7 da. of 9 hr. each?
12. The ratio of the weight of white pine to the weight of white oak is 17 to 27. A cubic foot of oak weighs 54 lb. Find the weight of a cubic ft. of white pine.
13. A man earns \$1300 in a year of 52 weeks; how much does he earn per week?
14. The interest on \$350 for 9 mo. is \$26.25. Find the interest for 7 mo. on the same sum.

IV. GENERAL REVIEW

EXERCISE 150

1. A merchant bought 845 bu. of wheat for \$574.60 and sold it at 85c. per bu. Find his profit and his gain per cent.
2. A house was insured for $\frac{3}{4}$ of its value at $\frac{1}{4}$ %. The premium was \$13.50. What was the value of the house?
3. A can do $\frac{1}{4}$ of a piece of work in 4 days, and B $\frac{1}{5}$ of it in 5 da. In what time can they do the whole, working together?

4. Divide 120 into three parts so that second part shall be double the first, and the third part as much as the sum of the other two parts.

5. A merchant marked his goods at 25% above cost, and deducted 12% of the amount of every bill of goods he sold. Find his gain per cent.

6. If a man can build $\frac{1}{4}$ of a wall in $8\frac{1}{2}$ da., how long will it take him to finish it?

7. What difference is there between a discount of 40% and 10%, and a discount of 30% and 20% off a bill of goods for \$1865?

8. How many board feet are there in 24 planks, 15 ft. long, 16 in. wide, and 6 in. thick?

9. If the divisor were one-fourth what it is, the quotient would be 948 and the remainder 85. Find the dividend, the divisor being 400.

10. At \$6.50 per cord, find the cost of a pile of wood 120 ft. long, 60 ft. wide, and 15 ft. high.

11. A drover bought 20 sheep for \$250, and 20 cows for \$950. He sold the sheep at a gain of $12\frac{1}{4}\%$ and the cows at a gain of $4\frac{1}{4}\%$. Find his total gain.

12. In three regiments there are 4800. The 2nd regiment has twice as many men as the 1st, and the third has 600 men short of having three times as many as the first. How many men are there in each regiment?

13. What fraction increased by 16% of itself becomes $\frac{2}{3}$?

14. A man built two houses at a cost of \$2785 each. He sold them both, gaining 15% on the one and losing 5% on the other. Find his total gain.

15. The premium on 4800 yd. of cloth was \$175. The insurance was on $\frac{1}{4}$ of the value of the cloth at $3\frac{1}{4}\%$. Find the price per yard of the cloth.

16. An agent sold a house for \$2500 and remitted \$2370 to his employer. At what rate did he charge commission?

17. A father's age is three times that of his son, and their ages added together amount to 64 years. How old is each?

18. Find the cost of 3 bu. 2 pk. 1 gal. 1 pt. of oats at \$1.75 a bushel.

19. A house which cost \$3600 rents for \$32.50 a month. The annual expenses on it are \$50. What rate per cent. does the owner receive for his investment?

20. Find the result when five hundred and twenty-five ten-thousandths are taken from ten thousands and the remainder is multiplied by ten hundredths.

21. A lady spent \$63 for jewellery and dress goods paying 16% more for dress goods than for jewellery. How much did she pay for each?

22. If 78 be added to a certain number it will contain eighty-seven 1005 times. Find the number.

23. Simplify .6 of $4\frac{1}{2}$ of $\frac{8}{\frac{1}{3} \text{ of } 6}$.

24. What principal will amount to \$810.96 in 1 yr 6 mo. at 6%?

25. How much duty must be paid on 125 gal. of wine worth \$225 upon which the duty is \$1.65 per gallon and 30% *ad valorem*?

26. Find the sum of .6; .014 and 4.234.

27. From 3.186 take 1.237.

CHAPTER VIII

INVOLUTION AND EVOLUTION

I. INVOLUTION

EXERCISE 151

INTRODUCTORY

1. What is the product when 2 is used as a factor twice? 3 times? 4 times?

2. What is the product when 3 is used as a factor twice? 3 times? 4 times? 5 times?

58. The product obtained by taking a number a number of times as a factor, is called a *power* of that number. The power is known by the numbers of times the number is taken as a factor,—thus, 2 is the first power of 2; 4 is the second power, 8 is the third power; 16 is the fourth power.

59. The second power of a number is called its *square*, and the third power its *cube*.

3. Find the square of 7; of 5; of 9; of 12.

4. Find the cube of 3; of 4; of 5; of 7.

5. Find the fourth power of 2; of 3; of 5; of 6.

6. How often is 2 taken as a factor to produce 8? 32? 64?

60. The number of times a number is used as a factor to produce a power, is indicated by a figure placed to the right and a little above the number. This is called the *Exponent* or *Index*,—thus, in $8=2^3$, 3 is the index.

7. Indicate that 5 is to be taken as a factor 4 times; that 6 is to be taken as a factor 3 times.

8. State to what the following are equal: 2^4 , 3^3 , 5^3 , 9^2 , 12^3 .

EXERCISE 152

Square the following numbers:

- | | | |
|----------------------|----------------------|-----------------------|
| 1. 23. | 5. $2\frac{1}{2}$. | 9. 367. |
| 2. $25\frac{1}{2}$. | 6. $17\frac{1}{2}$. | 10. $36\frac{1}{2}$. |
| 3. $17\frac{1}{2}$. | 7. 8.5. | 11. $\frac{1}{4}$. |
| 4. 97. | 8. 7.9. | 12. $7\frac{1}{4}$. |

EXERCISE 153

Cube the following numbers:

- | | | |
|--------|---------------------|-----------------------|
| 1. 19. | 5. 4.5. | 9. 207. |
| 2. 75. | 6. $2\frac{1}{2}$. | 10. $36\frac{1}{2}$. |
| 3. 87. | 7. $3\frac{1}{2}$. | 11. 24.5. |
| 4. 95. | 8. 7.4. | 12. $7\frac{1}{2}$. |

EXERCISE 154

Raise the following numbers to the powers indicated:

- | | | |
|-------------|----------------|--------------------------|
| 1. 94^2 . | 5. $(.07)^3$. | 9. $(1\frac{1}{2})^3$. |
| 2. 25^3 . | 6. $(.15)^3$. | 10. $(\frac{2}{3})^4$. |
| 3. 16^3 . | 7. $(2.5)^3$. | 11. $(2\frac{1}{2})^3$. |
| 4. 85^2 . | 8. $(.33)^4$. | 12. $(3\frac{1}{2})^3$. |

EXERCISE 155

Find the value of the following expressions:

- | | | |
|-----------------------|------------------------|--|
| 1. $2^3 \times 3^2$. | 5. $12^3 + 6^3$. | 9. $(\frac{1}{2}) + (\frac{1}{3})$. |
| 2. $5^3 \times 2^2$. | 6. $15^4 + 5^3$. | 10. $(\frac{1}{3}) \times (\frac{1}{4})^4$. |
| 3. $8^3 + 2^3$. | 7. $3^4 \times 3^3$. | 11. $(1.9)^5 + 19$. |
| 4. 17^2 . | 8. $10^4 \times 5^3$. | 12. $29^2 + (2.9)^4$. |

EXERCISE 156

1. Write the squares of the numbers from 13 to 20 inclusive.

2. Cube the odd numbers from 10 to 20.

3. What power of a number is the product of the first power, the third power, and the fourth power?

4. When the second power of a number is multiplied by its third power, what is the resulting power?
5. Of what number is 5007 one of the two equal factors?
6. Of what number is 202 one of the three equal factors?
7. Find the number of which one of the four equal factors is .5.
8. A rectangular field is 54 rd. long and 36 rd. wide. Find the area of a square field with an equal perimeter.
9. When the seventh power of a number is divided by its fourth power, which power of that number is the quotient?
10. Simplify the following expressions:
 $(2)^2$; $(3^2)^3$; $(4^3)^2$.
11. What power of a number is the cube of the square of that number?
12. The square of $\frac{1}{2}$ of a number is what part of $\frac{1}{2}$ of the square of that number?

II. SQUARE ROOT

EXERCISE 157

INTRODUCTORY

1. What is the *second* power of 5? of 9? of 12?
2. What number multiplied by itself will produce 36? 49? 121? 81?
3. Find the number whose *second* power is 9; is 25; is 64; is 144.
4. Resolve each of the following numbers into *two equal factors*: 16, 25, 81, 49, 100.
61. One of the *two equal factors* of a number is called its *Square Root*.
5. Find the square root of 9; of 36; of 64; of 144.

6. Square integral numbers of one digit and ascertain the number of figures in the square of a number of one figure.

7. Square integral numbers between 10 and 99 and find the number of figures in the square of a number of two figures.

8. Square integral numbers between 100 and 999 and ascertain the number of figures in the square of a number of three figures.

9. If 82369 is the square of a number, how many figures are there in the number?

10. Tell the number of figures in the square root of the following numbers: 841, 2304, 9801, 88804, 6889, 776161.

11. How many figures are there in the square root of the following numbers: A number of 3 figures; of 6 figures; of 4 figures; of 2 figures; of 7 figures?

12. How many figures are there in a number in which there are 3 figures in its square root?

13. Make a general rule showing the relation between the number of figures in any number and the number of figures in its square root.

EXERCISE 166

INTRODUCTORY

1. Examine the following method of squaring 25:

$$\begin{array}{r}
 25 = \qquad \qquad 20+5 \\
 25 = \qquad \qquad 20+5 \\
 \hline
 125 = \qquad \qquad 20 \times 5 + 5^2 \\
 500 = \qquad \qquad 20^2 + 20 \times 5 \\
 \hline
 625 = \qquad 20^2 + 2 \times 20 \times 5 + 5^2 \\
 \qquad \qquad = 20^2 + (2 \times 20 + 5) \times 5.
 \end{array}$$

2. Square 43 in a similar way and examine the result.

3. Square 56 in a similar way and examine the result.

4. How is the square of a number, consisting of a number of tens plus a number of units, found?

5. Write down the square of $(40 + 7)$.
 6. Indicate, as in Example 1, the square of 78.

Example 1. Find the square root of 2025.

$$\begin{array}{r}
 2025(45 \\
 16 \\
 \hline
 85 \overline{)425} \\
 \underline{425} \\
 0
 \end{array}
 \qquad
 \begin{array}{r}
 1600 + 2 \times 40 \times 5 + 5^2(40 + 5 \\
 1600 \\
 \hline
 2 \times 40 + 5 \quad 2 \times 40 \times 5 + 5^2 \\
 \underline{2 + 40 \times 5 + 5^2}
 \end{array}$$

Since the square of tens is hundreds, the part of 2025 expressed by 25 contains no part of the square of the tens. These figures are, therefore, disregarded for the present. The greatest square in 20 hundred is 16 hundred, the square root of which is 4 tens.

The remainder, 425, is equal to twice the tens plus the units multiplied by the units. Twice the tens is 8 tens; 8 tens is contained in 42 tens 5 times.

Twice the tens plus the units is 85, and 85 multiplied by 5 is 425. The square root is 45.

EXERCISE 160

Find the square root of:

- | | | |
|---------|----------|-----------|
| 1. 289. | 5. 1296. | 9. 4096. |
| 2. 361. | 6. 5625. | 10. 1369. |
| 3. 576. | 7. 9025. | 11. 2209. |
| 4. 625. | 8. 2401. | 12. 3136. |

EXERCISE 160

Example 2. Find the square root of 4124961.

$$\begin{array}{r}
 4 \overline{)12} \overline{)49} \overline{)61} \text{ (2031)} \\
 4 \\
 \hline
 403 \overline{)1249} \\
 \underline{1209} \\
 4061 \overline{)4061} \\
 \underline{4061} \\
 0
 \end{array}$$

After finding the first figure of the root and subtracting its square from the left-hand period and bringing down the next period, 12, it is found that 40 is not contained in 12. A 0 is put in the root, and the next period is brought down. The part of the root already found is doubled and 40 is written as a divisor. It is called

400, and it is found that it goes into 1249 3 times; 3 is put in the root and annexed to the 40; 403 is now multiplied by 3; and the product, 1209, is written under the 1249, and subtracted, etc.

Find the square root of:

- | | | |
|------------|--------------|---------------|
| 1. 390625. | 5. 820836. | 9. 25080064. |
| 2. 262144. | 6. 734449. | 10. 19228225. |
| 3. 117649. | 7. 5764801. | 11. 44502241. |
| 4. 499849. | 8. 40005625. | 12. 61685316. |

EXERCISE 161

1. A man owns a farm in the form of a square, which contains 10 a. How many rods in length or breadth is it?
2. What would it cost to fence a square lot containing 160 a., at the rate of \$4 per rod?
3. I have a room in the form of a square, which requires 100 yd. of carpet to cover it. What is the size of the room, if the carpet is 1 yd. wide?
4. What is one of the equal factors of 15625?
5. A garden contains 1452 sq. yd., and it is 3 times as long as it is broad. Find its length and breadth.
6. A certain public hall in a city contains 2646 sq. ft. and its length is $1\frac{1}{2}$ times its breadth. What are the dimensions of the hall?
7. A merchant bought a certain number of yards of muslin, giving as many cents for each yard as there were yards. The whole cost \$72.25. How many yards did he buy and at what price per yard?
8. What must be the dimensions in feet and inches of a square garden-lot, which shall be equal to two rectangular ones measuring, respectively, 8 by 10 rd. and 8 by 18 rd.?
9. A rectangular court that is twice as long as it is wide contains 31250 sq. ft. How long and wide is it?
10. A body of soldiers in column forms 361 ranks 9 abreast. If they were drawn up in solid square, how many would there be in each face?

11. A piece of cloth is 5 times as long as broad, and costs £19. Supposing the price to be 4s. 9d. a square yard, find the dimensions of the piece.

12. The area of a square field is 10 a. What will it cost to build a wall around it at 85c. per square yard of walling, if the wall be 2 yd. high?

III. GENERAL REVIEW

EXERCISE 162

1. The difference between two numbers is 140. Two-fifths of the greater number equals three-fourths of the smaller. Find the two numbers.

2. A lot 88 ft. wide contains $1\frac{1}{2}$ a. Find the length of the lot.

3. A square field contains 22 a. 80 sq. rd. At the rate of $7\frac{1}{2}$ mi. per hour, how long will it take a boy to ride his bicycle round the boundary fence of the field?

4. A commission merchant received \$375 as his commission at $2\frac{1}{2}\%$ for purchasing 2500 bbl. of flour. Find the price paid per barrel.

5. Find the square root of 3032.7049 and 627264.

6. A certain work can be done by 6 men or 12 boys in 5 days. In how many days can the work be done by 8 men and 8 boys?

7. Find the difference in time between Rome, longitude $12^{\circ} 27' 14''$ E., and Chicago $87^{\circ} 35'$ W.

8. A farmer paid \$146.25 in taxes. The rate of taxation is \$12.50 per thousand. The assessed valuation is $\frac{3}{4}$ of the real value. Find the real value of the farm.

9. The longitude of Jerusalem is $35^{\circ} 32'$ E. When it is 7.30 a.m. at Winnipeg, longitude $97^{\circ} 7'$ W., what is the time at Jerusalem?

10. A rectangular lot 3 times as long as it is wide contains 4107 sq. yd. Find the dimensions of the lot.

11. Three men purchase a store, paying as follows: \$2500, \$3500, and \$3000 respectively. They gain \$5400. How much does each gain?

12. From two orchards 280 bbl. of apples were picked. One orchard produced $\frac{3}{4}$ as many barrels as the other. How many barrels were picked from each?

13. An agent sold 1200 bbl. of apples at \$2.75 a barrel on a commission of $2\frac{3}{4}\%$ and after deducting \$82, his second commission, invested the remainder in cloth at 25c. a yard. How many yards did he buy?

14. Find the difference between the interest on \$5000 at 8% for 2 yrs. when compounded annually and compounded half-yearly.

15. A bushel of Indian corn weighs 56 lb. and a bushel of wheat 60 lb. How many bushels of wheat will weigh as much as 1795 bu. of corn?

16. Reduce 17.25, .0625, and 3.75 to vulgar fractions in their lowest terms.

17. If a man can row $3\frac{1}{4}$ mi. an hour in still water, how many miles can he row in $4\frac{1}{2}$ hr. up a river that flows at the rate of $\frac{7}{8}$ miles an hour?

18. A cistern has two supply pipes and a discharge pipe. If the supply pipes will fill it in 3 hr. and 4 hr. respectively and the discharge pipe will empty it in 2 hrs. and all three pipes are opened when the cistern is already half full, in what time will it be full?

19. A farmer offered to sell a cow for \$40. He sold her at 10% discount and made 20% gain. How much did the cow cost him?

20. If I received \$81.12 as interest on \$845 for 1 yr. 6 mo., at what rate did I loan the money?

21. Eighty-seven and a half per cent. of a number is $24\frac{1}{2}$ less than the number. Find the number.

22. Find the omitted term in the following:

(a) \$12: \$30:: ? : 270 yd.

(b) $8\frac{1}{4}$: $1\frac{1}{4}$:: $487\frac{1}{2}$: ? .



(c) 70 bu.: ? :: \$34 : \$136.

23. A man wishes to get \$500 from the Imperial Bank to pay a debt. He gives his note for 3 mos. (days of grace included) which, discounted at 8%, just produces this sum. For how much was the note drawn?

CHAPTER IX

MENSURATION

I. INTRODUCTORY

1. (a) Draw a rectangle 2 in. by 4 in.
(b) Point out the boundaries of the rectangle.
(c) Compare the lines bounding the rectangle with lines like  or .

The boundary lines of the rectangle are straight lines. Lines like those in (c) are curved or crooked lines.

2. Draw two straight lines that meet at a point but are not in the same straight line.

62. The difference in direction of two straight lines which meet is called an *angle*.

3. Draw two straight lines across each other so as to form four equal angles.

63. When two straight lines cut each other so as to make four equal angles, each angle is called a *right angle*.

64. Angles less than right angles are *acute angles*. Angles greater than right angles are *obtuse angles*.

4. (a) Draw a four sides figure with opposite sides parallel and its angles right angles.

(b) Draw a four sides figure with opposite parallel but its angles not right angles.

(c) Draw any other kind of four sides figure.

65. Any four sided figure is a Quadrilateral. A quadrilateral with its opposite sides parallel is a parallelogram.

66. A parallelogram with its angles right angles is a *rectangle*.

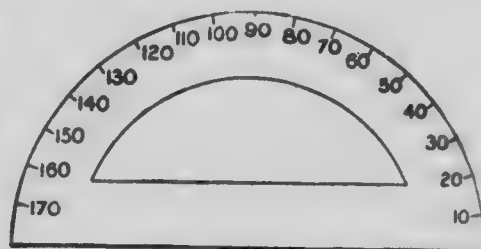
5. (a) Draw a rectangle 2 in. by 3 in.

(b) Draw a rectangle with all its sides equal.

67. A rectangle in which the sides are not all equal is an *oblong*.

68. A rectangle in which all the sides are equal is a *square*.

6. Draw this figure on cardboard and cut it out. It is called a protractor. Measure an angle of 60° ; of 90° ; of 75° ; of 120° ; of 10° ; of 45° .



7. Draw two lines, one due east and from one end of this line, another due north. What kind of an angle do they form? How many degrees are there in this angle?

8. Observe this page, the top of the desk, the wall of the school, the floor.

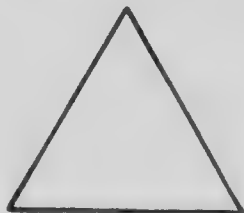
The outside of any object is called the *surface*. Measure this page; the top of the desk; the blackboard.

(a) How long is each?

(b) How wide is each?

69. Every surface has two dimensions, viz.: its *length* and its *breadth*.

9. Find the dimensions of this page; the top of your desk; of the blackboard.



10. (a) Enclose a space by means of three straight lines.

(b) How many angles has this figure?

62. A figure bounded by three straight lines is a *Triangle*.

11. (a) Draw a triangle with one of its angles a right angle.

(b) Draw a triangle with one of its angles greater than a right angle.

(c) Draw a triangle with each of its angles less than a right angle.

70. A triangle with one of its angles a right angle is a *Right Angled Triangle*.

71. A triangle with one of its angles greater than a right angle is an *Obtuse Angled Triangle*.

72. A triangle with each of its angles less than a right angle is an *Acute Angled Triangle*.

12. Using the Protractor, draw the following triangles:

(a) A right angled triangle.

(b) One with an angle of 120° .

(c) One with each angle 60° .

(d) One with angles of 90° , 45° , 45° .

(e) One with angles of 120° , 30° , 30° .

II. THE RECTANGLE

EXERCISE 163

INTRODUCTORY

Examine this figure.

1. What is its shape?
2. What is a rectangle?
3. If it is 8 in. long, what is its area? 8 ft. long? 8 yd. long? 8 rd. long?

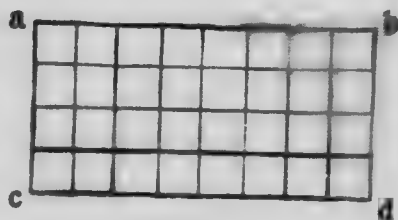


FIG. 1

4. (a) Draw a rectangle 6 in. by 4 in. and divide it into square inches.
- (b) How many square inches are there in one row along the side?
- (c) How many rows are there with 6 sq. in. in each row?
- (d) What is the area of your rectangle?

5. Show by a diagram that a rectangle 7 in. long and 4 in. wide contains 28 sq. in.
6. Draw a rectangle 5 in. long containing 20 sq. in. and find how wide it is.
7. Show that a rectangle containing 72 sq. in. and 9 in. long is 8 in. wide.

EXERCISE 164

1. How many square yards are there in the surface of a table 1 yd. 2 ft. 3 in. long by 1 yd. 9 in. wide?
2. A county ditch 18 ft. wide and 105 rd. long was dug diagonally across a farm. How many square rods did the owner lose?
3. A farmer buys a farm of 100 a. at \$45 per acre, across which a river runs diagonally. If the river measures 87 ft. wide and 62 rd. long, how much is the land worth that it covers?
4. Find the cost of gilding the entire outside surface of a covered box, 3 ft. long, 2 ft. 6 in. wide, and 1 ft. 9 in. deep, at \$1.20 per square foot.
5. At \$15 per M, board measure, what will be the cost of 2-in. plank for a 4-ft. sidewalk half a mile long?
6. Trees are planted 12 ft. apart round the sides of a rectangular field 40 rd. long, containing 2 a. Find the number of trees.
7. One blackboard in a school is 4 ft. wide and 16 ft. long; the other is $3\frac{1}{2}$ ft. wide and 24 ft. long. How many feet must be cut off the length of the larger blackboard so that the remainder will have the same area as the smaller one?
8. A square plot of grass measures 18 ft. 8 in. long, but in the centre is a square flower-bed 4 ft. 6 in. long. Find the extent of the grass surface.
9. A field whose length is to its width as 4 to 3, contains 2 a. 2 ro. 32 rd. What are its dimensions?

10. A room 15 ft. wide and 18 ft. long is covered with matting at a cost of \$25. What would be the expense of covering, with the same quality of matting, a room a yard longer and a yard wider?

11. A map is drawn to the scale of $\frac{1}{2}$ an inch to a mile. How many acres are represented by a square inch on the map?

EXERCISE 165

1. A room is twice as long as it is wide, and its floor area is $76\frac{1}{8}$ sq. yd. Find its length and width.

2. At 30c. per roll of 8 yd., what will be the cost of paper for the walls and ceiling of a room, the paper being 18 in. wide, the room being 24 ft. long, 21 ft. wide, and 12 ft. high, and no deductions being allowed for openings?

3. A railing encloses a rectangular field of 15 a. The length of the field is to its breadth as 3 to 2. Find the length of the railing.

4. In what time would a field 80×60 rd. pay for under-draining lengthwise at 2c. per foot, if the field yield 2 bu., at 66c. per acre, more than before draining? The drains are 4 rd. apart and the first drain runs down the centre of the field.

5. I bought a bush farm, 180 rd. long by 96 rd. wide, at \$12.50 per acre. I paid \$14.75 per acre for clearing and \$1.35 per rod for enclosing the whole farm with wire fencing. Taking into account that I sold the wood for \$1160 and ashes for \$17.20, how much has the improved farm cost me per acre?

6. A map measures 4 ft. 6 in. by 3 ft. 3 in. and is drawn on the scale of $\frac{1}{2}$ in. to a mile. How many acres does the map represent?

7. On a map drawn to the scale of $\frac{1}{2}$ in. to a mile, a township measures $3\frac{1}{2}$ in. long by $1\frac{1}{2}$ in. wide. How many acres are there in it?

8. A four-foot sidewalk of 2 in. planks is to be laid round a square field containing 10 a. The inner edge

of the sidewalk is to be two feet out from the boundary of the field. Find the cost of planking in the sidewalk at \$15 per M.

9. Find the cost of fencing a square lot containing $2\frac{1}{2}$ a. with wire fencing five wires high, at 2c. per foot.

10. Find the cost of covering the floor of a hall $54\frac{1}{2}$ ft. long and 16 ft. 8 in. wide with linoleum at \$.96 per square yard.

11. If it cost \$285 to fence a rectangular field 98 rd. by 72 rd., what will it cost to fence a square field of the same area?

III. THE PARALLELOGRAM

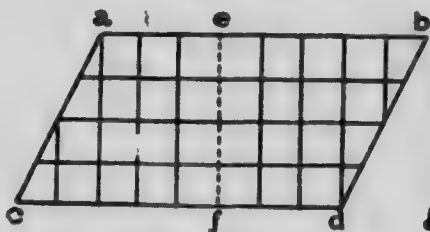


FIG. 2

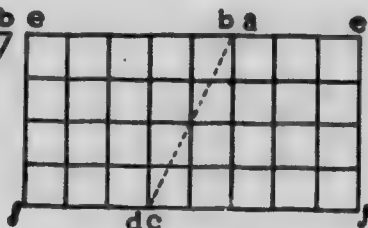


FIG. 3

78. A *Parallelogram* is a four-sided figure whose opposite sides are parallel.

Make a parallelogram $a c d b$, Fig. 2, from a piece of board about half an inch thick. Divide vertically as in $e f$ and insert pins so that it may be easily put together again. Change the parallelogram into a rectangle.

1. (a) Compare the length of the rectangle with the length of the parallelogram.

(b) Compare the breadth of the rectangle with the perpendicular height of the parallelogram.

(c) Compare the area of the rectangle with that of the parallelogram.

(d) How is the area of any parallelogram found?

2. Find the area of the following parallelograms:

(a) Length 3 ft. 4 in., perpendicular breadth 2 ft. 6 in.

(b) Length 24 ch. 6 l. perpendicular breadth 16 ch. 25 l.

(c) Length 40 rd. 4 yd., perpendicular breadth 24 rd. 5 yd.

3. Fill in the blanks in the following:

Length of parallelogram	Perpendicular breadth	Area
36 ft.	—	882 sq. ft.
500 rods	14 ch.	3.5 a.
	25½ ch.	—

1. A county ditch 18 ft. wide and 105 rods long was dug diagonally across a farm; how many square rods did the owner lose?

2. A farmer buys a farm of 100 acres at \$45 per acre, across which a river runs diagonally. If the river measures 87 ft. wide and 62 rods long, how much is the land worth that it covers?

3. How many rectangles, each having a base 12 ft. long and a breadth of 8 ft., would be required to have the same area as a parallelogram 48 ft. long with a perpendicular height of 12 ft.?

4. If a parallelogram 16 ft. long and 12 ft. wide were changed into the form of a rectangle, what would be the area of the rectangle?

IV. THE RIGHT-ANGLED TRIANGLE

EXERCISE 166

INTRODUCTORY

1. (a) Draw a rectangle 4 in. by 3 in. and join two of its opposite corners.

(b) Compare the areas of the two triangles so formed.

2. (a) Draw a rectangle 5 in. by 4 in. and join the opposite angles.

(b) What is the area of each triangle?

(c) What part of the area of the rectangle is the area of each of the triangles?

3. (a) Draw a straight line 5 in. long. At right angles to this line from one end, draw a straight line 6 in. long, and join the extremities of these two lines.

(b) Find the area of the right-angled triangle so formed.

4. (a) Draw an oblique parallelogram and join two of its opposite corners.

(b) Compare the area of each triangle thus formed with that of the parallelogram.

5. How does the area of any triangle compare with that of a parallelogram formed by drawing lines parallel to any two of the sides of the triangle?

74. The sides which enclose the right angle of a right-angled triangle are called the *Base* and *Perpendicular*.

75. The side opposite to the right angle is the *Hypotenuse*.

6. Draw a right-angled triangle and name its three sides.

Find the area of each of the following right-angled triangles:

7. Base 6 in., perpendicular 9 in.

8. Base 1 ft. 3 in., perpendicular 1 ft. 4 in.

9. Base 2 ft. 5 in., perpendicular 1 ft. 3 in.

10. How is the area of a right-angled triangle found?

11. Draw right-angled triangles of the following dimensions:

(a) Base 3 in., perpendicular 4 in.

(b) Base 12 in., perpendicular 5 in.

(c) Base 8 in., perpendicular 15 in.

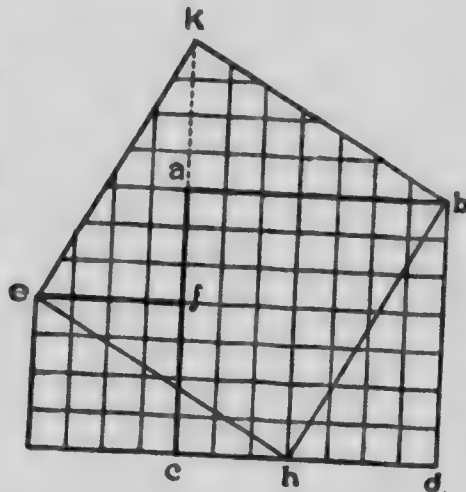
(d) Measure the length of the hypotenuse in each case.

12. In example (a), erect squares on each of the three sides and compare the sum of the areas of the squares on the base and perpendicular with the area of the square on the hypotenuse.

13. Do the same with examples (b) and (c).

14. In these three examples, how does the area of the square on the hypotenuse compare with the sum of the areas of the squares on the other two sides?

15. Examine this figure.



(a) Compare the length of $g c$ with that of $h d$.

(b) What kind of a triangle is $h d b$?

(c) Point out the square on the perpendicular $b d$.

(d) Point out a square equal to that on the base $h d$.

(e) Of what does the figure $e g d b a f$ consist?

(f) Compare the triangle $h d b$ with $e f k$ and $e g h$ with $k a b$.

(g) Compare the square $e h b k$ with the figure $e g d b a f$.

(h) The square $e h b k$ is on which side of the triangle $h d b$?

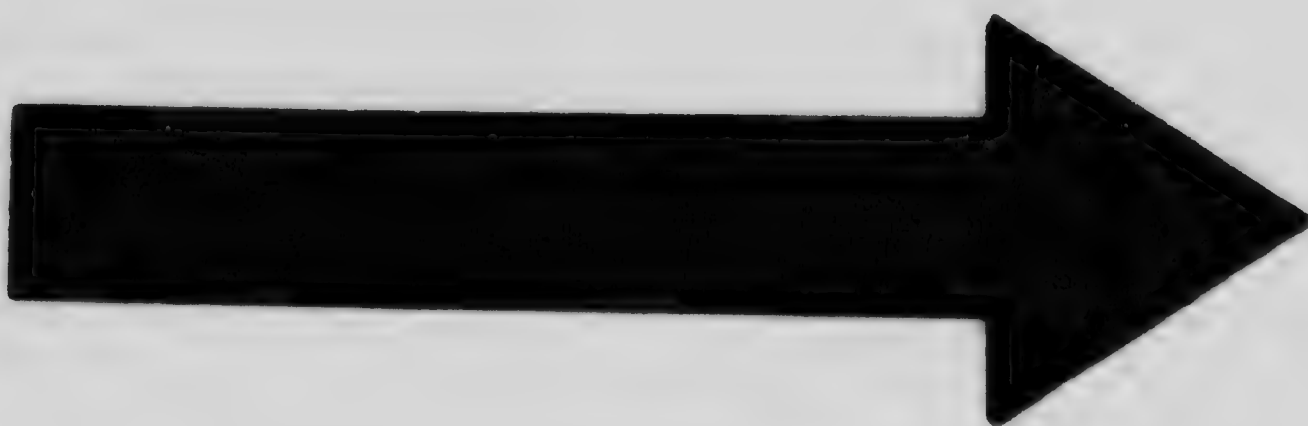
(i) What inference do you draw with reference to the square on the hypotenuse and the sum of the squares upon the other two sides of any right-angled triangle?

EXERCISE 167

Find the areas of the following right-angled triangles:

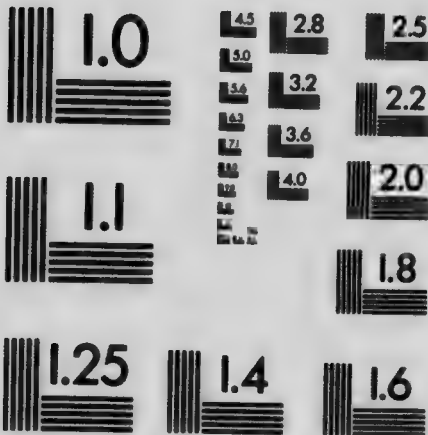
1. Base $6\frac{1}{2}$ yd. and perpendicular 13 yd.
2. Base 10 yd. 2 ft. and perpendicular 10 yd. 2 ft.
3. Base 3 chains and perpendicular 40 yd. 1 ft.

Find the perpendicular in the following right-angled triangles:



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4. Area 195 sq. ft. and base 26 ft.

5. Area $76\frac{1}{2}$ a. and base 7200 links.

Find the base in the following right-angled triangles:

6. Area $2\frac{1}{2}$ a. and perpendicular 110 yd.

7. Area 33.124 a. and perpendicular 1820 links.

EXERCISE 168

Find the hypotenuse of each of the following right-angled triangles, whose base and perpendicular are, respectively:

1. 35 ft. and 12 ft.

2. 31 ft. 6 in. and 56 ft. 8 in.

3. 408 ft. and 506 ft.

Find the base of each of the following right-angled triangles, whose perpendicular and hypotenuse are:

4. 36 in. and 85 in.

6. 24 chains and 74 chains.

5. 117 ft. and 125 ft.

7. 1 ft. 2 in. and 4 ft. 2 in.

Find the perpendicular of the following right-angled triangles, whose base and hypotenuse are, respectively:

8. 56 yd. and 394 yd.

9. 2 rd. and 3 rd. 5 yd. 6 in.

10. 1 chain, 40 links and 5 chains.

11. Find the area of the following figure:

AC = 1.26 in.

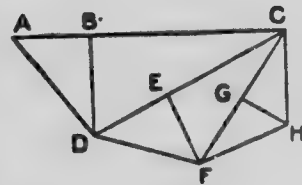
BD = .55 in.

CD = .95 in.

EF = .4 in.

CF = .71 in.

GH = .21 in.



EXERCISE 169

1. If the gable end of a house 64 ft. wide is 24 ft. high, what is the length of the rafters?

2. Find the width of a house whose rafters are 12 ft. and 16 ft. respectively, and form a right angle where they meet.

3. A ladder 85 ft. long stands close against a building. How far must it be drawn out at the foot that the top may be lowered 1 ft.?

4. A tree was broken 51 ft. from the top, and fell so that the end struck 24 ft. from the foot. What was the length of the tree?

5. A owns a rectangular lot 168 ft. by 95 ft. What is the distance through it from opposite corners?

6. A rope 190 ft. long will reach from the top of a pole to a point on the opposite bank of a river whose width is 152 ft. Find the height of the pole.

7. A ladder 34 ft. long stands upright against a wall. If it is pulled out 16 ft. at the bottom, how far will the top be lowered?

8. Two towers 94 ft. and 78 ft. high are on opposite banks of a stream 30 ft. broad. What is the length of the shortest line connecting the tops of the towers?

9. A field in the form of a right-angled triangle has a base of 720 feet and a hypotenuse of 962 ft. Find the cost of fencing it at 21c. per foot.

10. What is the shortest distance between the lower corner and the upper opposite corner of a room 60 ft. long, 32 ft. wide, and 51 ft. high?

11. What is the length of the longest straight rod which, without bending, can be put into a box 5 ft. long, 1 yd. wide, and $\frac{3}{4}$ yd. deep?

V. THE CIRCLE

EXERCISE 170

INTRODUCTORY

1. (a) With a pair of compasses or a pencil and string describe a circle.

(b) Point out the centre; the radius; the diameter; the circumference.

(c) What relation does the radius bear to the diameter?



(d) Every point in the circumference is at what distance from the centre?

76. A plane figure bounded by a curved line such that every point in the circumference is at the same distance from the centre, is a *Circle*.

2. Procure a round ruler 1 in. in diameter and find what length of string will just reach round it.

3. If possible, measure a cylinder 7 in. in diameter to find what length of string will just reach round it.

4. Measure the circumference and diameter of a stove pipe and compare the length of the circumference with that of the diameter.

77. It is found that the circumference of a circle divided by the diameter = 3.1416, which is usually denoted by the Greek letter π . For practical purposes $\pi = 3\frac{1}{2}$.

EXERCISE 171

Find the circumference of circles whose diameters are:

- | | | |
|----------------|----------------|----------------------|
| 1. 35 ft. | 4. 1 rd. 5 yd. | 7. 20 ft. |
| 2. 91 chains. | 5. 3 ch. 50 l. | 8. 4 ch. 76 l. |
| 3. 4 yd. 2 ft. | 6. 7 ch. 84 l. | 9. 5 yd. 1 ft. 4 in. |

Find the diameter of circles whose circumferences are:

- | | | |
|------------------|--------------|------------------|
| 10. 44 in. | 13. 264 in. | 16. 64 rd. |
| 11. 10 ft. 1 in. | 14. 3520 ft. | 17. 5 ch. 39 l. |
| 12. 3 yd. 2 in. | 15. 15.4 mi. | 18. 73 yd. 1 ft. |

19. The radius of a circle is 24 in. Find its circumference.

20. A wire may be so bent as to enclose a square whose area is 484 sq. in. If this wire were bent into the form of a circle, what would be its radius?

21. The radius of a fountain is 21 ft. Find the cost of enclosing it with an iron railing, at \$3.60 per yard.

22. A locomotive is travelling at the rate of 60 mi. per hour, and the diameter of its driving wheel is 3 ft. 6 in. How many times does it turn in a second?

EXERCISE 172

INTRODUCTORY

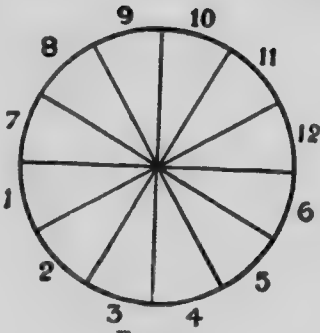


FIG. 3

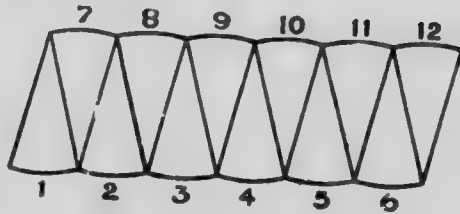


FIG. 4

1. From a piece of leather or tough paper make a circle and divide it into triangles as in Fig. 3. Change the circle into the form of Fig. 4. Into what shape, nearly, has the circle been changed?
2. If the circle had been cut into twice as many equal parts and arranged as in Fig. 4, it would still more nearly resemble the shape of what figure?
3. (a) What is the length of Fig. 4, in terms of the circumference?
- (b) What is the width of the figure, in terms of the radius?
4. Compare the area of Fig. 4 with that of the circle in Fig. 3.
5. If Fig. 4 is 2 in. long and 7 in. wide, what is its area?
6. What is the area of a circle 7 in. in radius?
7. What is the area of a circle 14 in. in radius?
8. How is the area of a circle found?

EXERCISE 173

Find the area of circles with the following diameters:

- | | | |
|-----------|------------|---------------|
| 1. 84 in. | 3. 525 ft. | 5. 483 links. |
| 2. 98 yd. | 4. 133 ft. | 6. 126 ft. |

Find the area of circles with the following circumferences:

- | | | |
|-----------------|------------|----------------|
| 7. 77 in. | 9. 220 yd. | 11. 473 links. |
| 8. 90.2 chains. | 10. 3 rd. | 12. 1 mi. |

Find the area of circles with the following radii:

- | | | |
|-----------------|---------------|-----------------|
| 13. 3 ft. 6 in. | 15. 7 chains. | 17. 1 rd. 5 yd. |
| 14. 7 ft. 7 in. | 16. 1.75 rd. | 18. 35 chains. |

EXERCISE 174

1. How many square yards of cement would be required to cover a circular hall 45 ft. in diameter?

2. The circumference of a race track is 1 mi. What is its area?

3. How many feet of iron must a blacksmith buy for the tires of 12 wheels 4 ft. in diameter?

4. What space would the driving wheel of a locomotive 5 ft. 3 in. in diameter pass over in making 25 revolutions?

5. Find the radius of a circle equal in area to the sum of three circles whose radii are 8 in., 9 in., and 12 in.

6. A circular lawn 220 yd. in diameter is surrounded by a gravel path 12 ft. wide. Find the cost of making the path at 36c. per square yard.

7. Two circles the radii of which are $3\frac{1}{2}$ in. are placed upon one whose diameter is 14 in. Find the area of the surface not covered.

8. The diameter of a circle is 126 in. Find the length of an arc of 50° ; of 65° ; of 80° ; of 90° .

9. A circular lawn contains $2\frac{1}{2}$ a. Find its radius.

10. A circle 5 ft. 2 in. in diameter has another 2 ft. 4 in. in radius inscribed within it. Find the area of the part of the large circle without the smaller one.

11. The diagonal of a square is $5\frac{1}{2}$ ft. Find the circumference of a circle circumscribed about the square.

12. A circle whose diameter is 14 in. has 100 Canadian cents placed upon it. Find the area of the part of the circle not covered by the cents.

Fig. 8 is a Rectangular Solid of which $a b c d$ is its upper surface. As in the rectangle, Page 173, lines are drawn dividing the sides into equal squares. The number of cubic units of measure which can be placed on the line $b c$ corresponds to the number of linear units of measure in that line; and the number that can be placed on the surface $a b c d$ is the number on $b c$ multiplied by the number of linear units of measure in the adjacent side $a b$. If the number of cubic units of measure on $a b c d$ be multiplied by the number of linear units of measure corresponding to the height of the solid the product will evidently be the number of cubic units of measure in the whole solid.

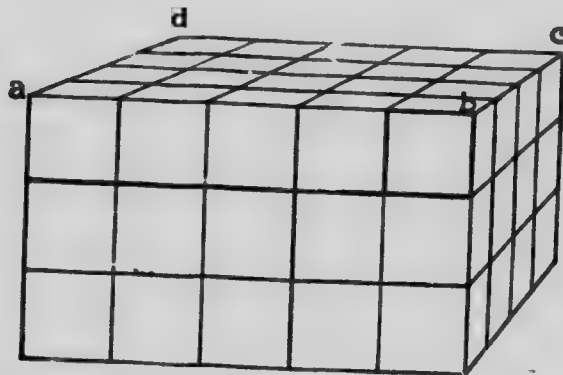


FIG. 8

Hence, to find the number of cubic units of measure in a rectangular solid, *multiply the number of cubic units of measure that can be placed on a line called the breadth, by the number of linear units of measure in the length, and this product by the number of linear units of measure in the height.*

VI. RECTANGULAR SOLIDS

EXERCISE 175

1. Find (a) the surface area and (b) the volume of a cube whose edge is $4\frac{1}{2}$ in. long.

Find (a) the surface area and (b) the volume of the following covered boxes:

2. Length 6 ft., width $2\frac{1}{2}$ ft., depth $3\frac{1}{2}$ ft.
3. Length 9 in., width $4\frac{1}{2}$ in., depth $2\frac{1}{2}$ in.
4. How many 2-in. cubes will be required to build a cube with an edge 12 in. long?
5. How much does the surface area of the small cubes in example 4 exceed that of the large one?
6. A schoolroom 34 ft. by 25 ft. is intended to accommodate 50 pupils. What must be its height to allow 250 cu. ft. of air-space for each pupil?
7. Find the volume of a cube, the area of whose entire surface is 7 sq. ft. 6 sq. in.
8. A piece of copper 1 ft. long, 9 in. wide, and $\frac{5}{8}$ in. thick is rolled into a plate 6 ft. long and 4 ft. wide. How thick will the plate be?
9. A log of square timber is 18 ft. long, 18 in. broad, and 15 in. thick. If $2\frac{1}{2}$ solid feet are cut off the end of it, what length is left?
10. A cistern is partly full of water and has 250 gal. in it. If the length of the cistern be $6\frac{1}{4}$ ft. and the breadth $3\frac{1}{2}$ ft., find the depth of the water.
11. A cistern is $12\frac{1}{2}$ ft. long and 8 ft. wide. If when it is full of water 1500 gal. are drawn off, how much will the surface of the water sink?

EXERCISE 176

1. A rectangular room 15 ft. high, whose length is one-half more than its width, contains 12960 cu. ft. of air space. Find its length.
2. A rectangular tank holds $12\frac{1}{2}$ t. of water. If it is 16 ft. long and 4 ft. wide, how deep is it, supposing 1 cu. ft. of water to weigh 1000 oz.?
3. A closed tank made of plank 2 in. thick, is 10 ft. long, 4 ft. wide, and 5 ft. 4 in. deep, external measurement. How many gallons of water will it hold, a gallon of water being $\frac{4}{8}$ of a cubic foot?
4. The surface area of a rectangular solid 1 ft. 3 in. long and 14 in. wide is 1000 sq. in. Find its depth.

5. A brick with mortar occupies a space 9 in. long, $4\frac{1}{2}$ in. wide, and 3 in. deep. How many bricks will be required for a wall 90 ft. long, $13\frac{1}{2}$ in. thick, and 6 ft. high?

6. A rectangular block of wood measures 20 ft. by 1 ft. 10 in. by 1 ft. 3 in. What length must be cut off it to contain 11 cu. ft.?

7. A rectangular cistern 8 ft. long and $6\frac{1}{4}$ ft. wide is full of water. How much will the water sink when 1000 gal. are drawn off?

8. It costs \$584.50 to excavate the basement of a rectangular building $125\frac{1}{4}$ ft. long and 28 ft. wide, at 25c. per cubic yard. How deep was the excavation?

9. A cubic foot of copper is rolled into a sheet 48 ft. long and 4 ft. wide. How thick is the sheet?

10. A rectangular cistern 4 ft. long and $3\frac{1}{2}$ ft. wide has 500 gal. of water in it. How deep is the water?

11. A cubic foot of swamp oak weighs 43 lb. Find the weight of 15 planks, each 24 ft. long, 14 in. wide, and 3 in. thick.

12. Water in freezing expands 10%. How many loads of ice of 2 tons each will be required to fill an ice house 44 ft. long, 40 ft. wide to a height of 20 feet, assuming that a cubic foot of water weighs 1000 oz.?

VII. THE CYLINDER

EXERCISE 177

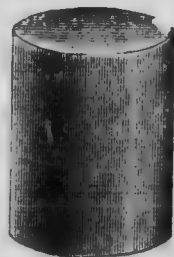
1. Examine a cylinder.

(a) How many parts are there in its surface?

(b) What is the shape of each end face?

(c) Compare the areas of the end faces.

(d) Imagine a straight line joining the centres of the two end faces; at what distance from this line is every part of the curved face?



2. Describe a cylinder.
3. (a) Fit a sheet of paper over the curved face of a cylinder.
 (b) Examine the shape of this sheet.
 (c) Compare the area of the sheet with the area of the curved face.
 (d) State the dimensions of the sheet of paper in terms of the dimensions of the cylinder.
 (e) How is the area of the sheet of paper found?
 (f) How is the area of the curved face of a cylinder found?
4. (a) A cylinder is 7 in. in radius and 12 in. long. Find the area of its surface.
 (b) What is the area of one end? Of the two ends?
 (c) What is the length of the circumference of the cylinder?
 (d) What is the area of the curved face?
 (e) What is the area of the entire surface?

EXERCISE 178

Find the surface of each of the cylinders whose diameter and height are, respectively:

- | | |
|----------------------------------|--------------------------|
| 1. 42 in. and 40 in. | 4. 126 in. and 20 ft. |
| 2. $3\frac{1}{2}$ in. and 10 in. | 5. 21 ft. and 4 ft. |
| 3. 14 ft. and 5 ft. | 6. 8 ft. 2 in. and 4 ft. |

Find the volume of each of the cylinders whose diameter and height are, respectively:

- | | |
|----------------------------------|------------------------|
| 7. 14 in. and 1 ft. | 10. 14 ft. and 5 ft. |
| 8. 42 in. and $3\frac{1}{2}$ ft. | 11. 21 ft. and 6 ft. |
| 9. 3 ft. 6 in. and 15 in. | 12. 105 in. and 16 ft. |

Find the diameter of each of the cylinders whose solid content and height are, respectively:

- | | |
|-----------------------------|---|
| 13. 308 cu. in. and 8 in. | 16. $115\frac{1}{2}$ cu. ft. and 12 ft. |
| 14. 1331 cu. in. and 14 in. | 17. 2079 cu. ft. and 24 ft. |
| 15. 385 cu. ft. and 10 ft. | 18. $513\frac{1}{2}$ cu. ft. and 40 in. |

EXERCISE 179

1. The area of the curved face of a cylinder is 440 in. It is 5 in. in radius. Find its height.
2. A roller is 6 ft. long and 3 ft. 6 in. in diameter. How much ground is rolled in 1000 revolutions?
3. How often would the roller in the last example turn in rolling a 10-acre field?
4. Find the cost, at 25c. per square foot, of decorating the curved face of a pillar 21 ft. high and 18 in. in diameter.
5. It costs \$31.68 to decorate the curved face of a pillar 21 ft. high, at 36c. per square foot. Find the diameter of the pillar.
6. A cylinder of copper 1 ft. high and 7 in. diameter is rolled out into a plate 8 in. wide and $\frac{1}{4}$ in. thick. How long is the plate?
7. The cent is an inch in diameter and $\frac{1}{16}$ in. thick. How many cents can be coined from a cylinder of copper 6 in. in diameter and 1 ft. high?
8. Find the cost, at \$1.75 per cubic yard, of sinking a shaft 120 ft. deep and 6 ft. in diameter.
9. If a cubic foot of iron weighs 488 lb., find the weight of a solid iron pillar 14 ft. long and 9 in. in diameter.
10. How many cubic feet of earth must be taken out in digging a well 30 ft. deep and 6 ft. in diameter?

VIII. REVIEW

EXERCISE 190

1. Find the area of a board 5 ft. long, 12 in. wide at one end and 6 in. at the other.
2. Draw on paper a figure with two parallel sides 3 in. and 4 in. long and altitude 2 in. Find its area.
3. If a ton of coal is equal to 36 cu. ft., how many tons can be put into a bin $8\frac{1}{4}$ ft. wide, $8\frac{1}{2}$ ft. deep and 18 ft. long?

4. Find the volume of a cylindrical column 40 ft. high and 3 ft. in diameter.

5. A circular pond 5 ch. in diameter is covered with ice 8 in. thick. How many cubic feet of ice are there on the pond?

6. An ice dealer stored the ice from 5 a. of a lake. The ice was of an average thickness of 2 ft. Find the weight of ice, each cubic foot weighing $56\frac{1}{2}$ lb.

7. Find the cost of slating a roof 50 ft. 6 in. long at \$12.50 a square, each side of the roof being 24 ft. (A square = 100 sq. ft.)

8. A bushel contains 2218.2 cu. in. How many bushels will a bin 8 ft. long, 5 ft. wide, and 6 ft. deep contain?

9. A reservoir in the form of a cylinder is 350 ft. in diameter. How many gallons does it contain when filled to the depth of 20 ft.? (A cubic ft. = $6\frac{1}{4}$ gal.)

10. The area of a triangle is 250 sq. ft., its altitude is $6\frac{1}{2}$ ft.; find its base.

11. Find the area of a triangle with two equal sides each of which is 50 rd. long and the base 40 rd. long.

12. How far from the bottom of a building 70 ft high must the foot of a ladder 72 ft. long be placed so that it may just reach to the top of the building?

13. The sides of a rectangle are to each other as 3 to 4. The diagonal is 55 ft. long. Find its area.

14. Find the side of the largest square that can be inscribed in a circle 10 ft. in diameter.

15. Find the distance from a lower corner to the opposite upper corner of a rectangular room 32 ft. long, 24 ft. wide and 16 ft. high.

16. At \$2.25 a rod, how much less will it cost to fence a field 80 rd. square, than a field of the same area one-fourth longer?

17. A roof is 36 ft. long and each side is 24 ft. wide. Slates are 16 in. by 12 in. and lap 10 in. How many slates will it take?

18. How many board feet are there in 84 boards, each 7 ft long and 10 in. wide?

19. Estimate the number of gallons of water in a well $4\frac{1}{2}$ ft. in diameter when the water is 9 ft. deep.

20. A lot was bounded as follows:—beginning at the north-east corner, the line ran west 40 ft.; thence south 75 ft., thence east 100 ft.; thence to the north-east corner. Find the cost of sodding this lot at 15c per square yard.

21. A room is heated by 350 feet of steam pipe 2 in. in diameter. Find the area of the curved surface which radiates the heat.

22. How many gallons (277.274 cu. in.) of water are there in a cylindrical tank 35 ft. high and 21 ft. in diameter when it is full?

23. The globe in school is 12 in. in diameter. Find the length of the equator and of a degree of latitude at the equator.

24. At 84c. per sq. yd. it cost \$26.88 to pave a triangular court the base of which was 32 ft. Find the altitude of the court.

25. The perimeter of a square and the circumference of a circle are each 42 ft. Which has the greater area and by how much?

26. Find the cost of concreting the bottom of a circular fountain 63 ft. in diameter at \$1.50 per square yard.

27. Two vessels sail from the same port. One sails due north at the rate of 13 mi. per hr. and the other due west at the rate of 14 mi. per hour. How far apart are they at the end of 12 hr.?

28. Find the cost of material for a 4-ft. sidewalk 240 feet long of 2-in. plank resting on two rows of 2" x 6" scantling if lumber is worth \$26 per M.

29. The cost of building a sidewalk 120 feet long of 2-inch plank supported on two lines of 2" x 6" scantling at \$25 per M. was \$48. Find the width of the sidewalk.

30. A sidewalk 3 ft. wide of 2-inch plank supported by two rows of 2" x 5" scantling is built the full length of a block 500 ft. long. How much more would the sidewalk have cost had it been 5 ft. wide, lumber being worth \$28 per M?

31. How many sq. yds. of oilcloth are needed for a kitchen 15 ft. \times 21 ft., allowing 5 per cent more than the area for matching?

32. A farmer who has a section of wheat makes the first cut around it with a binder having a $5\frac{1}{2}$ ft. cutting-bar.

(a) How long will it take to make the first round if the horses travel at the rate of 3 miles an hour?

(b) How many acres does he cut the first round?

(c) If four binders each with a $5\frac{1}{2}$ ft. cutting-bar are set at work, how many acres remain uncut after each machine has made 18 rounds?

33. Find the cost of laying a granolithic sidewalk 120 feet long, 4 ft. wide, at 45c. per sq. yd.

34. Find the cost of cementing the floor of a cellar 18 ft. \times 15 ft., if it requires one cubic yard of gravel at \$1.50 a yard and 2 sacks of cement worth 90 cents a sack are required for every 3 square yards.

35. In question 28, had a granolithic walk been laid what would the cost have been (a) if the cost of laying it was 5 cents a square foot; (b) if it had cost 24 cents a running foot?

36. A close board fence 4 ft. high is built around a block of land 500 ft. long, 270 feet wide. The boards are nailed to two lines of 2" \times 4" scantling. Posts are placed 10 feet apart and cost 22c. each. Find the entire cost of the fence if lumber is worth \$27 per M.

37. A man who owns a corner lot 33 ft. by 132 ft. decides to build a picket fence on the street sides and a close board fence 4 ft. high on the inside of the lot. The posts cost 25 cents each and are placed 8 ft. 3 in. apart. The pickets are $2\frac{1}{2}$ " wide and are placed 2" apart and cost \$4.40 per 100. Two rows of scantling 2" \times 4" support the pickets and the boards. In the case of the picket fence a base board 12" wide is used, while a rain board costing 3 cents a foot is placed below the pickets. If lumber is worth \$27 per M, find the entire cost of the material, allowing \$2.75 for nails.

IX. GENERAL REVIEW

EXERCISE 181

1. Find the cubic contents of a cubical box, if the area of its faces is 24576 sq. in.

2. What change must I make in my watch in going from Calgary, longitude $102^{\circ} 33' W.$, to Paris, longitude $2^{\circ} 20' 22'' E.$?

3. *A* and *B* hired a pasture for \$50. *A* put in 60 sheep for 6 mo. and *B* 90 sheep for 4 mo. How much should each pay?

4. How many yards of paper 32 inches wide, with a pattern every 1 ft. 3 inches, are required to paper the walls of a room 20 ft. long, 12 ft. wide, and 12 ft. high?

5. Find the proceeds of a note for \$876 made on June 16 for 3 mo. and discounted July 8, at 6%.

6. A mill was insured for $\frac{3}{4}$ of its value at $\frac{1}{4}\%$. The premium being \$77.50, find the value of the mill.

7. When flour is selling at \$5.40 per barrel a merchant loses 10%. What would be his gain per cent. if he sold at \$6.50 per barrel?

8. The assessed value of the property of a town is \$2496000. The estimated expenses are for schools \$5400; for streets \$8600; interest on debentures \$10000; salaries and other expenses \$5952. Find Mr. Smith's tax whose real estate is assessed for \$8750.

9. Extract the square root of 9456.76 and of 32.7184.

10. Resolve the number 9216 into its prime factors and from these determine its square root.

11. If \$10920 includes the amount expended for hides and the agent's commission at $2\frac{1}{2}\%$, how much does the agent spend in buying hides?

12. A bankrupt has \$36384 assets, and \$72560 liabilities. The expense of settlement is \$3240. How much can he pay on the dollar?

13. Find the cost at 20c. per single roll of papering the

walls of a room 15 ft. long, 12 ft. wide and 8 ft. high with paper 18 inches wide with the pattern every 10 inches.

14. Find the cost of carpeting a room 18 ft. long, 14 ft. 6 inches wide with carpet 18 inches wide, at \$1.75 per yard, allowing 7 inches on each strip excepting the first for matching the pattern.

15. A room 12' long and 10'6" wide is to be carpeted with carpet 27" wide at \$1.45 per yard:

(a) How many strips would be required?

(b) How many inches would have to be turned under or cut off the last strip?

(c) Find the cost, allowing 8" off each strip except the first for waste in matching the pattern.

16. A farmer sold two horses for the same price, \$189. On one he gained $12\frac{1}{2}\%$ and on the other he lost $12\frac{1}{2}\%$. Find his total gain or loss.

17. Fill in the blanks:

Cost	Selling Price	Gain	Gain
\$40	\$54	?	?
\$240	?	?	$16\frac{2}{3}\%$
\$?	\$164	?	$33\frac{1}{3}\%$
\$?	\$56	\$14	?

18. I wish to obtain \$800 from the Traders Bank. For what sum must I give a note for 3 mo., if discounted at 6%?

19. The distance round a circular park is one mile. How many acres does it contain?

20. If the interest on \$1600 for 2 yr. 6 mo. is \$180, at what rate was it computed?

21. What is the value of a stock of goods if \$231 is paid for insurance on $\frac{1}{4}$ of their value at $\frac{1}{4}\%$?

22. A's share of the gain is $\frac{1}{3}$ of the whole. B's capital is \$7500. Find A's capital.

23. What sum will pay for a bill of goods for \$540, discounts of 25% and 5% being allowed?

24. How high must wood be piled in a car 38 ft. long and 8 ft. wide to contain 15 cords?

CHAPTER X

MISCELLANEOUS AND INDUSTRIAL PROBLEMS

EXERCISE 182

1. Find the cost of sending the following telegrams at 25c. for the first 10 words and 1c. for each additional word:

(a) 16 words; (b) 40 words; (c) 54 words.

2. How much will it cost to talk over a long-distance telephone for 7 min. at 75c. for the first 2 min. and 30c. for each additional minute?

3. Find the freight charges on 1750 lb. of sugar shipped from Toronto to Calgary at \$1.52 per cwt.

4. A piece of work has been half done by *A*, *B* and *C* working together in 8 da. If *A* and *B* together can finish it in 12 da., in what time could *C* have finished it?

5. A train 132 yd. long passes a post in 6 sec. At what rate per hour is the train moving?

6. A bin is 12 ft. long, 8 ft. broad, and when filled holds 2000 bu. How deep is it?

7. If a steer when killed and dressed weighs $\frac{7}{10}$ as much as when alive, what was the weight of one that weighed 756 lb. when dressed?

8. A farmer drew his produce to market, a distance of 4.75 mi., at a cost of \$2.42 per load. If each load has 66 bu., find the cost of moving his crop of 3450 bu.

9. A fruit grower shipped 1200 ten-pound boxes of cherries to Vancouver, where they were sold at 80c. per box. Picking and packing cost 1c. per lb., freight and refrigerator 20c. per box, and other expenses amounted to \$20. Find the net amount received by the fruit grower.

10. Solve the following and fill in the blanks:—

Cost	Selling Price	Gain in Dollars	Gain %
\$12	?	\$2.50	?
\$15	?	?	6%
?	\$18.50	\$4.50	?
?	\$18.50	?	7%
?	?	\$12.40	4%

11. A coal bin $10\frac{1}{2}$ ft. by $7\frac{1}{2}$ ft. by $5\frac{1}{2}$ ft. is filled with egg coal. How many tons are in it, if 1 ton occupies 35 cu. ft. of space?

12. Mark goods that cost as follows so that there will be a profit of 25% after giving the indicated discount:

- (a) Cost 48c., discount 20%.
- (b) Cost 54c., discount 10%.
- (c) Cost 80c., discount $16\frac{2}{3}$ %.

13. When coal at the mine costs \$2.80 per long ton, freight \$1.75 per short ton, cartage and delivery \$1.15 per short ton, what per cent of gain is made by a dealer who sells coal at retail at \$6.50 per short ton?

14. One year a coffee planter had 96 a. of land on which were planted 450 coffee trees per acre. Each tree yielded 1.8 lb. of raw coffee on the average, which was sold on the plantation at $6\frac{1}{2}$ c. per pound. It cost the planter $3\frac{1}{2}$ c. per lb. to raise the coffee. Find:

- (a) The number of lbs. of coffee sold.
- (b) The net gain of the planter.
- (c) The gain per cent. on his outlay if the plantation cost him \$10000.

15. At a factory where 1000 men and women are employed, the average daily wage is \$2.50 for a man and \$1.50 for a woman. The total wage per day is \$1750. How many men are employed?

16. In the Amazon valley a native tapped 250 rubber trees and secured $\frac{3}{4}$ gal. of milk from each tree. Each gallon of milk yielded $2\frac{1}{4}$ lb. of rubber. Between June and December the trees were tapped 12 times, each tapping yielding as much milk as the first. Find:

MISCELLANEOUS AND INDUSTRIAL PROBLEMS 197

(a) The number of pounds of rubber per tree obtained at each tapping.

(b) The total number of pounds collected during the season.

(c) If the rubber was sold in New York at \$1.45 per pound, find the sum received.

17. How far may a person go in an automobile at the rate of 25 mi. per hour and drive back at the rate of $7\frac{1}{2}$ mi. per hour, to be 65 min. away?

18. The average yield of wheat in various countries was as follows:—Canada, 21.4 bu., Great Britain 31.8 bu.; France 26 bu.; Germany 19.4 bu.; United States, 13.4 bu., Argentina 18.6 bu. Find the yield from 56 a. in each of these countries.

19. An Alberta farmer had a field of wheat 1 mi. long and $\frac{3}{4}$ mi. wide. In ploughing it, he used two gang ploughs each turning $12\frac{1}{2}$ a. per day of 10 hr. He sowed 6 pecks of seed to the acre at 90c. per bushel. The crop averaged 22.5 bu. per acre and was sold at the elevator at 65c. per bushel. The cost of ploughing, threshing, and transporting to the elevator amounted to $10\frac{1}{2}$ c. per bu. Find:

(a) The number of acres in the field.

(b) The number of days it took to plough the field.

(c) The cost of the wheat before it was stored in the elevator.

(d) The profit to the farmer from this field.

20. The hay from 15 acres was stored in a mow 40 ft. by 27 ft. and when well settled filled it to the depth of 20 ft. How many tons did the field yield per acre, if 450 cu. ft. of hay is 1 ton?

21. Each summer a farmer fills his coal bin with furnace coal for next winter. The bin is $8\frac{3}{4}$ ft. by 7 ft. by 6 ft. Find: (a) the number of tons he burns, 35 cu. ft. of hard coal being 1 ton; (b) the cost at \$7.25 per ton.

22. In what time would a field 80×60 rd. pay for underdraining lengthwise at 2c. per ft. if the field yield 2 bu., at 66c. per acre more than before draining?

The drains are 4 rd. apart and the first drain runs down the centre of the field.

23. I bought a bush farm, 180 rd. long by 96 rd. wide, at \$12.50 per acre. I paid \$14.75 per acre for clearing and \$1.35 per rod for enclosing the whole farm with wire fencing. Taking into account that I sold the wood for \$1160 and ashes for \$17.20, how much has the improved farm cost me per acre?

24. A map measures 4 ft. 6 in. by 3 ft. 3 in., and is drawn on the scale of $\frac{1}{4}$ in. to a mile. How many acres does the map represent?

25. At a cheese factory, milk was paid for according to the amount of butter fat it contained. How much did a farmer receive who brought 6400 lb. of milk that tested $3\frac{1}{4}\%$ of butter fat, the factory price of butter fat being $27\frac{1}{2}$ c. per pound?

26. A farmer, by feeding his cows \$2 worth of meal per day more than he had been feeding them, increased the percentage of butter fat from $3\frac{1}{4}\%$ to 4% and increased the daily yield of milk from 2000 lb. to 2250 lb. How much did he gain per day by the experiment, the price of butter fat being 28c. per pound?

EXERCISE 183

1. In 1901 the population of Canada was 5371315 and of these 3312593 were unmarried. What per cent. of the population were unmarried?

2. In 1891 Manitoba had 896622 a. under wheat and produced 16092220 bu. In 1901 it had 1965200 a. in wheat and produced 18353013 bu. Compare the average yield per acre in these two years.

3. In 1901 in the Territories, now the Provinces of Alberta and Saskatchewan, 1676545 lb. of cream were manufactured into 745134 lb. of butter and sold for \$152667, of which \$118085 was paid to the patrons of the butter factories; find the value of (a) cream per lb.; (b) butter per lb.

MISCELLANEOUS AND INDUSTRIAL PROBLEMS 199

4. In 1841 there were 16 mi. of steam railways in Canada; in 1851 there were 159 mi.; in 1861, 2146 mi.; in 1871, 2695 mi.; in 1881, 7331 mi.; in 1891, 13838 mi.; and in 1901, 18140 mi.

(a) Find the increase in mileage during each of these decades.

(b) Find the increase per cent. during each decade.

(c) During which period was there the greatest increase per cent.?

5. The Canadian Pacific Railway consists of 3971 mi. of main line, 2023 mi. of branches and 3202 mi. of leased lines.

(a) What per cent. of the whole railway is leased?

(b) The main line is what per cent. of the whole system?

6. The total cost of operating the 20487 mi. of railway in Canada in 1905 was \$79977574. How much was that per mile?

7. In 1905 there were 793 mi. of electric railways operated in Canada at an expense of \$5918194.

(a) How much was that per mile?

(b) Compare the expense of running electric railways with that of steam railways in Canada in 1905 (See question 6.)

8. At the close of 1901 there were 895 Post Office Savings Banks in Canada, and there was to the credit of the depositors \$39950813. What was the average deposit for every man, woman, and child in Canada. (See question 1.)

9. In 1905 there were 110 Money Order Offices in the Territories. There were 131681 Money Orders issued for \$2439394. Find the average number of orders issued by each office and the average value of each order.

10. In 1904 there were 193916100 two-cent postage stamps issued in Canada, and in 1905, 210605800. Find:

(a) The increase in value.

(b) The increase per cent. in the number.

11. In 1904 the fire insurance companies doing business in Canada received \$13169882 and paid in losses \$14099534. In 1905 they received \$14298750, and paid \$6008457.

(a) Find the per cent. of loss or gain during each year.

(b) Find the net gain during these two years.

(c) If the gross amount of policies issued was \$1140075512, in 1905, find the average rate of insurance.

12. A census table for Manitoba shows as follows:—

Year.....	1881	1891	1901
Population....	65954	152506	255211
Occupiers of land	9077	22571	32495

(a) Which is increasing more rapidly, the population or the occupiers of land?

(b) What per cent. of the population were occupiers of land during each census year?

13. In 1905 there were 24233 mi. of railway including sidings in Canada; there were 2906 engines in use, 1285 first-class passenger cars, and 57229 cattle and box cars. How many engines, passenger cars, and freight cars were there to each mile of railway?

14. The following table shows the quantity of preserved salmon and its value from British Columbia:—

Year	1900	1901	1902	1903	1904
Quantity...	3115588 lb.	59864176 lb.	30103776 lb.	22744656 lb.	22362912 lb.
Value	\$3050680	\$5986618	\$3010377	\$2274465	\$2236291

(a) Find the average price per pound of preserved salmon in B.C.

15. In the manufacture of agricultural implements, 4543 men were employed in 1891, their wages being \$1812050. In 1901, 5788 men received \$2129241 for this kind of labor:

(a) Find the average wage paid to a workman in each of these years.

(b) How much has the wages changed during the 10 years?

MISCELLANEOUS AND INDUSTRIAL PROBLEMS 201

16. The standard gauge on American and English railways is 4 ft. 8½ in. Express this in metres, the metre being 39.37 in.

17. In 1901 the food products of Canada were worth \$125202000. The textile products were 54½% of this; the iron and steel products 27.8%; the timber and lumber products 64%; and leather and its finished products 27.7%.

(a) Find the value of the textile products.

(b) Find the next most important Canadian industry after that of producing food products.

(c) Find the grand total of the industries mentioned in the example.

18. In 1891 there were 113811 a. in wheat; in 1901 there were 530274. In 1891 the yield was 1792409 bu. and in 1901 it was 5103972 bu.

(a) What was the yield per acre during each of these years?

(b) What was the per cent. of increase in the acreage?

(c) What was the per cent. of increase in the yield?

19. The average temperature of the Province of Ontario in 1905 was as follows:—January 13.6°, February 12.7°, March 27.2°, April 41.1°, May 52.7°, June 62.8°, July 68.7°, August 66.1°, September 60.9°, October 47.5°, November 33.7°, December 27.0°.

(a) Find the average temperature for the year.

(b) Find the average of the month of April, May, June, July, August, and September.

20. At Toronto during the month of July the sun is 470.9 hr. above the horizon. In 1905 there were 265.7 hr. of bright sunshine. What per cent. of the days were clear during this month?

21. In 1901 there were 4807 wage earners engaged in making carriages and wagons in Canada. They received \$1791981. Ten years before that there were 9056 wage earners and they received \$2999572. Had the wages increased or decreased per capita and how much?

22. Out of 5 lb. of food eaten by orioles, $12\frac{1}{2}$ oz. is vegetable food, the remainder being insects injurious to plants. What per cent. of the food is injurious to plants?

23. In 1901, Canada produced 582157 oz. of gold valued at \$9163443. What is an ounce of gold worth?

EXERCISE 184

1. The total mineral products of Canada in 1905 were \$27176504. Write the sentence in words.

2. Canada has 6558 steam engines, 244 gas engines and 2683 water wheels. Write this sentence, using Roman numerals.

3. Explain how you multiply a number by 10, by 100, by 1000, by merely moving the decimal point. Illustrate by multiplying 71.345 by each of these multipliers.

4. A has \$784; B has \$980. By how much per cent. must A 's money be increased to equal B 's?

5. Separate the number 7056 into its prime factors and from these determine its square root.

6. The diameter of a bicycle wheel is 28 in. Find the number of revolutions it makes in going one mile.

7. From a cellar 36 ft. long and 21 ft. wide there were taken 196 cu. yds. of earth. Find the depth of the cellar.

8. Reduce $.0072\frac{1}{2}$ and $.008\frac{1}{2}$ to equivalent vulgar fractions in their simplest form.

9. Reduce the ratio $9\frac{3}{4} : 20\frac{1}{4}$, to an integral form in its lowest terms.

10. A base ball "diamond" is 90 ft. square. Find the distance between two diagonally opposite corners.

EXERCISE 185

1. Divide the sum of eighteen ten thousandths, one hundred and six millionths, eighty-four hundredths, and five hundred and nine ten thousandths by fifteen millionths.

MISCELLANEOUS AND INDUSTRIAL PROBLEMS 203

2. A gallon measure holds 277.27 cu. in. and a cubic foot of water weighs 62.5 lbs. Find the weight of water in a bushel measure when full.

3. The sum of two numbers is 100. If the first number were multiplied by 2 and the second were increased by 10, the numbers would be equal. Find the numbers.

4. A sold a horse to B gaining 25%. B sold the horse to C at a gain of 10%. What did the horse cost A if C paid \$176 for it?

5. Successive trade discounts of 25%, 10%, and 5% are equivalent to what single discount?

6. A merchant sends his agent \$5000 to purchase hay after deducting his commission of 2%. How much was spent in buying hay?

7. The half-yearly interest on a mortgage at 6% per annum is \$285. What is amount of the mortgage?

8. Divide 104 into three parts which shall be to one another in the ratio of $2\frac{1}{2}$, $3\frac{1}{2}$, and 5.

9. The bottom of a rectangular cistern is 7 ft. 6 in. by 3 ft. 2 in. How deep must it be to contain 4275 lb. of water when full, a cubic foot of water weighing $62\frac{1}{2}$ lb.?

10. If a man inhales 25 c. in. of air at each breath and breathes 16 times in the minute, how long does it take him to inhale 10 c. feet of air?

11. In measuring cloth a yard stick is used which is $\frac{1}{2}$ in. too short. Find the length of 144 yds. measured by this stick.

12. What is the combined length of four boards whose lengths are 5.5 ft., $7\frac{1}{2}$ ft., $9\frac{1}{2}$ ft., and 12.8 ft.?

13. How much will it cost to insure a cargo of 4000 t. of coal valued at \$3.25 per ton for $\frac{2}{3}$ of its value at $\frac{1}{2}\%$?

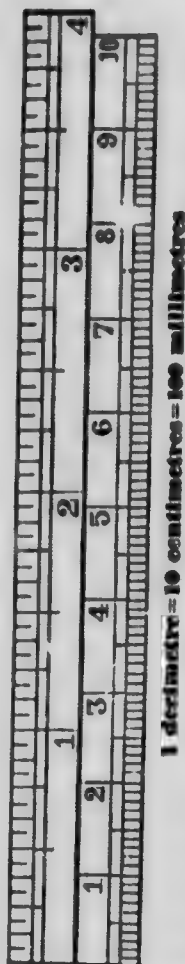
14. If the mercury in a barometer falls 1 in. for 1000 ft. of ascent, what will be the difference between the height of the barometer at the base and summit of a mountain 13750 ft. high?

EXERCISE 186

1. If a cubic foot of water weighs 1000 ounces and mercury is 13.59 times as heavy as water, find the weight of a cubic inch of mercury.
2. Find the area of a triangle whose base is 13 yd. 1 ft. 6 in. and its altitude $8\frac{1}{2}$ ft.
3. Construct an isosceles triangle with a base 8 in. long and each of the equal angles at the base 60° . Find its area.
4. The side of an equilateral triangle is 12 in. long. Find its area.
5. Find the area of the curved surface of a cylindrical standpipe 28 ft. in diameter and 60 ft. high.
6. A butcher buys an equal number of cows, pigs, and sheep. Each cow cost \$32.75, each pig \$8.25, and each sheep \$4.50. He pays \$3640 in all. How many of each does he buy?
7. Simplify $(84 \times 36 \times 96 \times 51 \times 48) + (17 \times 7 \times 3^3 \times 2^5)$.
8. A room is 32 ft. by 28 ft. It has three windows each containing 12 panes of 30 in. by 22 in. Find the ratio of the floor space to the window space.
9. If a man travels away from home $7\frac{1}{2}$ h. at the rate of $6\frac{1}{4}$ mi. per hour, how long will it take him to return at the rate of $4\frac{1}{2}$ mi. per hour?
10. In a rectangular garden 150 ft. by 100 ft. there are two circular flower beds each 21 ft. in diameter and 4 oblong beds each $12\frac{1}{2}$ ft. by $10\frac{1}{2}$ ft. The rest is in grass. How much is in grass?
11. From the top of a triangle whose base is 24 in. and altitude 16 in., a small triangle is taken off by a line parallel to the base, so that the altitude of the small triangle is 8 in. and its base 12 in. Find the area of the part remaining.
12. Find the weight of air in a room 70 ft. by 35 ft. by 16 ft. Air weighing .0012 times as much as water.
13. About 75% of potatoes is water. Find the weight of dry matter in 240 bu. of potatoes.

CHAPTER XI

THE METRIC SYSTEM OF WEIGHTS AND MEASURES



78. In 1795 France adopted a system of Weights and Measures called the Metric System, based upon the decimal system of notation, all the divisions and multiples being by 10. It has since been adopted by most of the nations of Europe and is in partial use in Canada and the United States.

79. Unit of Length. The metric standard for measurement of distance is the *Metre*, which is 39.37 inches long, or almost 3 ft. $3\frac{3}{8}$ in.

From the Metre all the other measures of this system are derived, hence the name *Metric System*.

The metre was defined by a law of the French Republic to be the distance between the ends of a rod of platinum made by Borda, the temperature being that of melting ice. It was supposed that this rod represented one ten-millionth part of the distance from the earth's equator to the pole. It has since been found that this is not exactly the case, and thus the metric standard is not the terrestrial globe but Borda's platinum rod.

The annexed diagram represents one-tenth of a metre in length and is called *decimetre*. It is sub-divided into ten equal parts, each of which is called a *centimetre*, and each of these again into ten equal parts, each of which is called a *millimetre*.

80. Unit of Volume. The unit of volume depends directly on the unit of length. The capacity of a box

one-tenth of a metre (a decimetre) long, wide, and deep is the standard unit of measure. Such a measure is called a *Litre*, and is equal to 1.761 pints (imperial).

81. *Unit of Weight.* The weight of so much distilled water at a temperature of 4°C. as would fill a measure one-hundredth of a metre (a centimetre) long, wide, and deep is the standard unit of weight, and is called a *Gram*.

82. By using Latin and Greek prefixes denominations higher and lower than the standard units are formed, the Greek numerals indicating multiples and the Latin ordinals indicating decimal divisions, thus:

Deca	stands for	10	} times the unit.
Hecto	"	100	
Kilo	"	1000	
Deci	"	10th	
Centi	"	100th	} part of the unit.
Milli	"	1000th	

METRIC TABLES

83.

MEASURES OF LENGTH

The unit is the Metre.

10 <i>millimetres</i> (mm.)	= 1 <i>centimetre</i>	= .01 metre.
10 centimetres (cm.)	= 1 decimetre	= .1 "
10 decimetres (dm.)	= 1 <i>metre</i>	= 1. "
10 metres (m.)	= 1 decametre	= 10. "
10 decametres (Dm.)	= 1 hectometre	= 100. "
10 hectometres (Hm.)	= 1 <i>kilometre</i>	= 1000. "
10 kilometres (Km.)	= 1 myriametre	= 10000. "

NOTE.—Metre = 39 $\frac{1}{4}$ in. nearly; 70 yd = 64 metres nearly.
1 kilometre = 1100 yd. nearly; 8 km. = 5 mi. nearly.

The measures more commonly used are in italics.

Cloth, etc., is measured by the *metre*; very small distances by the *millimetre*; great distances by the *kilometre*.

A rough rule for converting metres into English yards is to add 10 per cent. to them; thus 40 metres are equal to 44 yards.

The centimetre is nearly equal to $\frac{1}{25}$ in., hence to convert centimetres to inches, multiply by 4 and point off the last figure.

To convert millimetres to inches or decimals of the inch: Multiply by 4 and point off the last two figures.

EXERCISE 187

1. How many metres in a decametre? In a hectometre? In a kilometre? How many decametres in a hectometre? In a kilometre?

2. What part of a metre is a decimetre? A centimetre? A millimetre?

3. With a metre-stick or a string one metre in length measure the height of your desk; the length and width of the schoolroom; the length and width of the platform; the width of the nearest street. Measure the foregoing with a yard measure. Convert the metric measures into feet and inches approximately and compare with the actual measurement by these units.

4. Find the value of each of the following expressions in metres:

(a) .435 m. + 825 cm. + 4263 mm. + .1595 Km.

(b) .927 Km. - 6495 cm.; 4.37 cm. - 42.87 mm.

(c) $8 \times .0457$ Km.; 38019 mm. + .097.

5. Find the cost of 83.75 m. of cloth at \$3.25 per metre.

6. The expense of building a certain railroad is \$25000 per kilometre. What is the whole cost of the road if its length is 72 Km. and 53 m.?

7. The length of the tunnel through Mont Cenis is about 12.22 Km. What is this in miles very nearly?

8. The width of the Atlantic is about 3000 mi. What is its width in kilometres?

9. A train is running at the rate of 48 Km. an hour. How many metres does it travel in a second?

10. Reduce 27 m. to the fraction of 36 Km.

11. Take 31 Km. 3 Hm. 9m. from 115 Km. 2 Dm. 7 dm.

12. Find the total cost of 75 cm. at 4 francs per metre, 625 mm. at 8 francs per metre, 60 dm. at 12 francs per metre, and 7 m. 8 cm. at 25 francs per metre.

84. MEASURES OF SURFACE OR SQUARE MEASURE

100 sq. millimetres (sq. mm.)	= 1 sq. centimetre	=	.0001 sq. metre	
100 sq. centimetres (sq. cm.)	= 1 sq. decimetre	=	.01	"
100 sq. decimetres (sq. dm.)	= 1 sq. metre	=	1.	" = 1 centare
100 sq. metres (sq. m.)	= 1 sq. decametre	=	100.	" = 1 are.
100 sq. decametres (sq. Dm.)	= 1 sq. hectometre	=	10000.	" = 1 hectare
100 sq. hectometres (sq. Hm.)	= 1 sq. kilometre	=	1000000.	

NOTE.—The are, centare, and hectare are used only in land measure.

The are is slightly less than 4 sq. rd.

The hectare is slightly less than $2\frac{1}{2}$ a.

Since the scale is 100 (10×10), there are two places for each denomination. Thus 5 hectares, 2 ares, 5 centares is written 5.0205 hectares, or 50205 square metres.

EXERCISE 183

1. Write 12 square kilometres as square metres.
2. Write 8 square metres and 35 square decimetres as square metres.
3. A farmer had 5 hectares 5 ares 9 centares of land and sold first .5, then .3 of it for \$384 an are. What did he get for what he sold? How much had he left?
4. Find in square metres the area of a room 4.53 m. long and 2.75 m. wide.
5. Divide 73 sq. m. by 25.
6. How many square millimetres are there in a square metre?
7. Find the area in square metres of a lot 4 dm. square.
8. Find the area of a floor 15 m. 68 cm. long and 7 m. 2 cm. 5 mm. wide.
9. Find the cost of carpeting a rectangular room 16 m. 2 dm. 4 cm. long, 7 m. 8 dm. 5 cm. wide with carpet 6 dm. 2 cm. 8 mm. wide, at \$5 per metre.
10. A rectangular field has an area of 43 ares 5 centares; its length is 150 m. What is its breadth in metres?

THE METRIC SYSTEM OF WEIGHTS AND MEASURES 209

11. A rectangular surface measures 1 sq. m.; it is 1 cm. wide. Find its length.

12. How many bricks each 16 cm. long and 8 cm. wide will be required to pave a walk 24.8 Km. long and 2.4 m. wide?

85.

MEASURES OF CAPACITY

1000 cu. millimetres (c.mm.)	= 1 cu. centimetre	= .000001 cu. metre.	
1000 cu. centimetres (c.cm.)	= 1 cu. decimetre	= .001	= 1 litre.
1000 cu. decimetres (c.dm.)	= 1 cu. metre	= 1.	= 1 stere.

NOTE.—In measuring wood a cubic metre, called a *stere* (st.), is used; $3\frac{1}{10}$ steres = 1 cord nearly.

In measuring liquids the cubic decimetre, called a *litre*, is used. Four litres = seven pints very nearly.

In measuring grains, fruits, etc., the hectolitre is used.

The numeral prefixes are used with the litre as with the metre.

EXERCISE 189

- Write 5.14 cubic decimetres as cubic metres.
- Write 8765345 cubic centimetres as cubic metres.
- Add 3 cu. m. 18 cu. dm. 207 cu. cm.
385 cu. m. 230 cu. dm. 895 cu. cm. 10 cu. mm.
831 cu. m. 300 cu. cm.

Express the sum in cu. metres, then in cu. dm.

- How many steres of wood are there in a pile 26 m. long, 2.25 m. wide, and 3 m. high?

- Find the cost of 27.5 Hl. of wheat at \$0.13 per decalitre.

- How many litres will a rectangular box 1.5 m. long, .72 m. wide, and .84 m. deep hold?

- How many litres are there in 75 decalitres?

- A family consumes 2 litres 4 dl. of milk daily. Find the weekly cost at 6c. per litre.

- What is the volume of rectangular stone 2 m. long, 8 dm. broad, and 5 dm. 6 mm. thick?

- How many phials, each holding 2.5 centilitres, may be filled from a vessel containing $2\frac{1}{2}$ litres?

EXERCISE 190

1. Write in full the table of Dry, or Liquid Measure.
2. Write 4 litres and 8 decalitres as litres.
3. Write 175.4 decilitres as litres.
4. At \$2 a litre, what is the price of a centilitre?
5. How much must I pay for 56.25 litres of coal oil at $18\frac{3}{4}$ c. a litre?
6. How many litres are there in a cubic metre?
7. How many gallons are there in 20 litres?
8. A merchant bought 10 hectolitres of potatoes at \$1 per hectolitre, and sold them at 50c. a bushel. Did he gain or lose, and how much?
9. How many litres are there in a rectangular tank 3.5 m. long, 2.6 m. wide, and 3.1 m. deep?
10. Taking a pint as equivalent to .568 l., how many hectolitres correspond to 3125 bu.?

86.

MEASURES OF WEIGHT

10 milligrams	(mg.) = 1 centigram	=	.01 gram.
10 centigrams	(cg.) = 1 decigram	=	.1 "
10 decigrams	(dg.) = 1 gram	=	1. "
10 grams	(g.) = 1 decagram	=	10. "
10 decagrams	(Dg.) = 1 hectogram	=	100. "
10 hectograms	(Hg.) = 1 kilogram	=	1000. "

NOTE.—A *cubic centimetre* of water at its greatest density weighs one *gram*. This is the unit of weight.

A gram = $15\frac{1}{2}$ grains nearly; 28 grams = 1 oz.. Avoir. nearly.

The *gram* is used in weighing letters, mixing and compounding medicines, and in weighing all light articles.

The *kilogram* equals about $2\frac{1}{2}$ lb. Avoirdupois. It is the ordinary unit of weight.

In weighing heavy articles two other weights, the *quintal* (100 kilograms) and the *tonneau* or *ton* (1000 kilograms), are used. The ton is a little less than 2205 lb.

A *litre* of water weighs 1 kilogram.

A cubic metre of water weighs 1000 kilograms.

EXERCISE 191

1. Write 7 kilograms and 18 grams as grams.
2. Write 277 centigrams as grams.
3. Write 12 grams, 2 centigrams, and 1 milligram as grams.
4. At \$6 a ton for coal, what will it cost to heat a building 30 days if it takes 400 kilograms of coal a day?
5. How many grains are there in 2 grams?
6. How many pounds Avoirdupois are there in 976.25 grams?
7. How many grams are there in 12 lb. Troy? In 12 lb. Avoir.?
8. The French post-office allows 7.5 grams for a single postage; the Canadian 1 oz. Avoir. By how many grains does the Canadian exceed the French allowance?
9. The pressure of the atmosphere on a certain day was $14\frac{3}{4}$ lb. Avoir. to the square inch. What would be the corresponding pressure in kilograms to the square centimetre?
10. Each soldier in a garrison consumes daily 8.5 Hg. of bread. In 25 da. the entire garrison consumes 53125 Kg. How many soldiers are there in the garrison?

REVIEW

EXERCISE 192

1. In a 3-metre square there are how many square decimetres?
2. How many square centimetres are there in an oblong 5 dm. by 6 dm.?
3. The base of a triangle is .9 dm., and the altitude is 64 dm. Find the area.
4. The perimeter of a rectangle is 60 m. and the length is to the breadth as 3 to 2. Find the length, breadth, and area.
5. How many acres are there in a field 72.5 m. by 62.8 m.?

6. A boy rode on his bicycle 2645 m. in 5 min. At this rate how far would he ride in $1\frac{1}{2}$ hr.? Express the answer in kilometres.

7. Divide 16 Hl. of wheat equally among 20 persons. Express the answer in litres.

8. In a right-angled triangle the base and perpendicular are respectively 24 dm. and 70 dm. long. Find the hypotenuse.

9. A bin is 12 m. long and 8 m. wide. How deep must it be to hold 1080 Hl. of wheat?

10. Write the following as cubic metres:

(a) 47 cu. m. 7 cu. dm. 8 cu. cm.

(b) 57 cu. m. 19 cu. dm. 84 cu. cm.

(c) 758 cu. m. 78 cu. cm.

11. The total surface of a cube is 2400 sq. m. Find its volume.

12. How many dekalitres of water will weigh 18.05 Kg.?

EXERCISE 193

1. Find in miles the length of 10 Km., a metre being 39.37 in.

2. How much is a pile of wood 8 m. long, 4.5 m. wide and 3.4 m. high worth at \$1.25 a stere?

3. Find the cost of 36.8 a. of land when \$750 is paid for 4.25 Ha.

4. The circumference of a wheel is 4.5 m. in length. How many revolutions will this wheel make in going 278.1 Km.?

5. How deep must a rectangular box be to hold 30 l. if it is 45 cm. long and 24 cm. wide?

6. What weight of water will fill a vat 96 dm. long, 75 dm. wide and 42 dm. deep?

7. If alcohol is 80% as heavy as water, find the weight of alcohol in a rectangular vessel 5 dm. by 4 dm. by 24 cm.

8. The circumference of Tom's hoop is 3.8 m. How many times will it turn in rolling a distance of 66.5 dm.?

9. A nickel 5-cent piece weighs 5 g. How many nickels can be made from a bar of coin metal weighing 7 Kg.?

10. How many cubic metres of earth must be removed in excavating a cellar 8.5 m. long, 6.4 m. wide and 2.2 m. deep?

EXERCISE 194

1. Compare the area of a rectangular field, whose length is three times its breadth, and perimeter 1200 m., with the area of a square field whose perimeter is 1000 m.

2. How many acres are there in one rectangular field 75 m. by 66 m.?

3. The diameter of a circle is 371 cm. long. Find its circumference and its area.

4. How much will it cost to paint the curved surface of a standpipe 20 m. high, and 8 m. in diameter at 25c. per square metre?

5. Reduce the following:

(a) 24.7 cu. m. to cubic decimetres.

(b) 1847689 cm. to metres.

(c) 87 Hg. to decigrams.

(d) 84 a. to sq. metres.

(e) 5.8 Kg. to centigrams.

(f) 49 sq. m. to sq. centimetres.

6. How many litres will a box hold which is 82 cm. long, 16 cm. wide and 15 cm. deep?

7. An empty jug weighs 1.04 Kg.; full of water it weighs 3.8 Kg. Find the capacity of the jug in litres.

8. Into how many lots of 4.25 a. may 8 ha. 5 a. be divided?

9. Find the weight of a bar of iron 50 cm. long, 4 cm. wide and 2.5 cm. thick, iron weighing 7.8 times as much as an equal volume of water.

10. Express in kilograms the weight of .375 cu. m. of water at its greatest density.

11. A ditch 90 m. long, 75 dm. wide and 50 dm. deep is full of water. Find its weight.

CHAPTER XII

TABLES OF WEIGHTS AND MEASURES FOR REFERENCE

Avoirdupois Weight

16 drams (dr.)	= 1 ounce	or 1 oz.
16 ounces	= 1 pound	" 1 lb.
100 pounds	= 1 hundred-weight, 1 cental, "	1 cwt.
20 hundred-weight	= 1 ton	" 1 t.

NOTE.—In Great Britain 112 lb. make a hundred-weight, and 2240 lb. make a ton, called the long ton.

Fluid Measure—Medicine

60 drops	= 1 dram.
8 drams	= 1 fluid ounce.
20 ounces	= 1 pint.
8 pints	= 1 gallon.
1 dram	= 1 teaspoonful.
2 drams	= 1 dessertspoonful.
4 drams	= 1 tablespoonful.

Long Measure

12 inches (in.)	= 1 foot	or 1 ft.
3 feet	= 1 yard	" 1 yd.
5½ yards	= 1 rod	" 1 rd.
40 rods	= 1 furlong	" 1 fur.
8 furlongs	= 1 mile	" 1 mi.

1 mi. = 320 rd. = 1760 yd. = 5280 ft. = 80 chains.

NOTE.—Gunter's chain is used in measuring land. It is 22 yards in length, and is divided into 100 links, each link being 7.92 inches long.

NOTE.— 6 feet	1 fathom.
120 fathoms	1 cable length.
880 fathoms	1 mile.

NOTE.—The Hand (the breadth of the hand and thumb) used in measuring the height of horses at the shoulder, is 4 inches.

Surface, or Square Measure

144 square inches (sq. in.)	= 1 square foot	or 1 sq. ft.
9 square feet	= 1 square yard	" 1 sq. yd.
30 $\frac{1}{4}$ square yards	= 1 square rod	" 1 sq. rd.
160 square rods	= 1 acre	" 1 a.
640 acres	= 1 square mile	" 1 sq. mi.

NOTE.—10,000 square links = 1 square chain.

10 square chains = 4840 sq. yds. = 1 acre.

160 a. = a quarter section land. | 640 a. = a whole section land

320 a. = a half section land. | = 1 sq. mi.

36 sections = 1 township (tp.)

Cubic or Solid Measure

1728 cubic inches (cu. in.)	= 1 cubic foot	or 1 cu. ft.
27 cubic feet	= 1 cubic yard	" 1 cu. yd.
128 cubic feet	= 1 cord	" 1 cd.

Measure of Capacity

2 pints (pt.)	= 1 quart	or 1 qt.
4 quarts	= 1 gallon	" 1 gal.
2 gallons	= 1 peck	" 1 pk.
4 pecks	= 1 bushel	" 1 bu.

1 cu. ft. of water weighs 1000 oz. and contains 6 $\frac{1}{4}$ gal.

The following table shows the weight of a bushel of the article named:

Lime	80 lb.	Parsnips	60 lb.	Buckwheat	48 lb.
Bituminous coal	70 lb.	Beets	60 lb.	Timothy seed	48 lb.
Beans	60 lb.	Wheat	60 lb.	Hemp seed	44 lb.
Clover seed	60 lb.	Indian Corn	56 lb.	Castor Beans	40 lb.
Peas	60 lb.	Rye	56 lb.	Malt	36 lb.
Potatoes	60 lb.	Flax seed	56 lb.	Oats	34 lb.
Turnips	60 lb.	Onions	50 lb.	Blue grass seed	14 lb.
Carrots	60 lb.	Barley	48 lb.		

Measure of Time

60 seconds (sec.)	= 1 minute	or 1 min.
60 minutes	= 1 hour	" 1 h.
24 hours	= 1 day	" 1 da.
7 days	= 1 week	" 1 wk.
12 calendar months or 365 days	= 1 year	" 1 yr.
366 days	= 1 leap year.	

Circular or Angular Measure

60 seconds (")	= 1 minute	or 1'.
60 minutes	= 1 degree	" 1°.
360 degrees	= 1 circumference	" 1 C.

English or Sterling Money

4 farthings (far.)	.	.	.	.	=	1 penny,	.	.	.	or 1d.
12 pence	.	.	.	.	=	1 shilling,	.	.	.	" 1s.
20 shillings	.	.	.	.	=	1 pound,	.	.	.	" £1.

NOTE.—£1 sterling = \$4.86 $\frac{1}{2}$, and 1s. = 24 $\frac{1}{2}$ cents.
1 Guinea = 21 Shillings

Miscellaneous Table

12 units	.	.	.	.	.	=	1 dozen,	.	.	.	or 1 doz.
12 dozen	.	.	.	.	.	=	1 gross,	.	.	.	" 1 gro.
12 gross	.	.	.	.	.	=	1 great gross	.	.	.	
20 units	.	.	.	.	.	=	1 score,	.	.	.	or 1 sco.
24 sheets	.	.	.	.	.	=	1 quire,	.	.	.	" 1 qr.
20 quires	.	.	.	.	.	=	1 ream,	.	.	.	" 1 rm.
196 lb. flour	.	.	.	.	.	=	1 barrel,	.	.	.	" 1 bbl.
200 lb. pork	.	.	.	.	.	=	1 barrel,	.	.	.	" 1 bbl.

Freezing point of water, on Fahrenheit scale, 32° above zero.

Boiling point of water, under a pressure of 760 mm., 212 F.

A board foot is 12 × 12 in. × 1 in.

A bunch of shingles contains 250. A thousand shingles are reckoned to cover 100 sq. ft.

A bundle of laths contains 50; each is 4 ft. long and 1 $\frac{1}{2}$ in. wide. When nailed they are left $\frac{1}{4}$ in. apart.

Light travels at the rate of 186000 mi. a second.

Sound travels in the air at the rate of 1100 ft. a second.

An Imperial gallon contains 277.274 cu. in.

The wine gallon contains 231 cu. in. 6 wine gallons = 5 standard gallons.

A bushel contains 8 imperial gallons.

The long ton is used in the United States custom houses and in wholesale transactions in iron and coal.

Atmospheric pressure. At the level of the sea the pressure of the atmosphere is about 14.7 lb. per square inch.

The barometer. The column of mercury falls about an inch for each 1000 ft. of ascent.

A brick is 8 in. long, 4 in. wide and 2 in. thick. About 22 bricks and the mortar will fill 1 cu. ft.

A lath is 4 ft. long and 1 $\frac{1}{2}$ in. wide. They are usually left $\frac{1}{4}$ in. apart when nailed. There are 50 laths in a bunch. A bunch will cover 3 sq. yd. of surface.

Wall paper in America is 18 in. wide and is put up in double rolls 16 yds. long. English wall paper is usually 21 in. wide.

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' £1.

or 1 doz.
' 1 gro.

or 1 sco.
' 1 qr.
' 1 rm.
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